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MEMOIRS

OF THE

GEOLOGICAL SURVEY OF INDIA.

Palæontologia Indica,

BEING

FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING
THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA IN COUNCIL,

UNDER THE DIRECTION OF
THOMAS OLDHAM, LL.D.
Fellow of the Royal and Geological Societies of London; Member of the Royal Irish Academy;
Hon. Mem. of Leop-Carolino Academy of Natural Sciences; of the Isis, Dresden: of the
Roy. Geol. Soc., Cornwall: Corr. Mem., Zool. Soc., London, &c., &c.,
SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

JURASSIC FAUNA OF KUTCH.

Vol. I. 1.

Ser. IX. 1. The CEPHALOPODA (Belemnitidæ and Nautilidæ),

by **WILLIAM WAAGEN**, Ph. D.,
Geological Survey of India.

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PRELIMINARY NOTICE.

THE first part of the figures and descriptions of the Cephalopod fauna of the Jurassic rocks of Kutch, is published herewith, including all the known *Belemnitidæ* and *Nautilidæ*. We most deeply regret that the illness of the author Dr. Waagen, which has compelled his temporary return to Europe, will prevent the continuous issue of the succeeding fasciculi. The greater portion of the manuscript is complete, and a large number of plates have also been prepared. Of these plates the entire series will occupy nearly sixty, from which fact the value of the collection may be roughly estimated. But independently of the number and variety of the species met with, these will have a special interest from their geological relations, and there is little difficulty in anticipating that the present, when complete, will be one of the most important contributions to the Cephalopod palæontology of the Upper Jurassic formations *(Callovien* to *Tithonien)* ever issued.

I sincerely hope that a few months may restore Dr. Waagen to good health, and also enable him to complete this great work, which he has commenced with such zeal and power.

CALCUTTA; }
March 1873. }

T. OLDHAM,
Supdt., Geol. Survey of India.

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INTRODUCTION.

The general considerations resulting from the study of the Jurassic Cephalopoda of Kutch, (or Kach'h), and the important bearing which they have upon more generally interesting questions in Geology and Palæontology, will be treated of at the end of this Monograph. For our present purpose it will be sufficient to say a few words relating to certain stratigraphical terms used in the following pages.

The composition of the Jurassic formation of Kutch is by no means so uniform as, until very lately, it appeared to be; for Dr. Stoliczka, on his recent visit to Kutch, was able to distinguish several divisions or groups based as well upon the palæontological, as upon the physical and geological relations of the rocks. Those divisions, however, as was to be expected, do not exactly correspond in their stratigraphical relations with the groups distinguished in European-Jurassic countries, and I have, therefore, drawn up the following general table in order to show these general relations of the Kutch, with the corresponding divisions of the European-Jurassic series, and thus to lead to a right understanding of the meaning and value of the terms used. For further details I must refer to Dr. Stoliczka's detailed paper on the subject, which will shortly appear in the Memoirs of the Geological Survey of India.

KUTCH.		EUROPE.	
GROUPS.	BEDS.	ZONES.	GROUPS.
	Beds with *Ancyloceras* and *Ammonites* of the *Rhotomagensis* group.		CRETACEOUS.
OOMIA GROUP ...	Sandstones and shales, etc., with *Palæozamia* and other plants.	?	TITHON. GROUP.
	Sandstones and conglomerates with marine fossils. *Perisph. transitorius, frequens*; *Trigonia*, etc.	Upper Tithon. Lower Tithon.	
KATROL GROUP ...	Sandstone and shales with *Phylloc. ptychoicum, Oppelia trachynota, Perisph. torquatus, Pottingeri*, etc.	Zone of *Perisph. mutabilis.* Zone of *Oppelia tenuilobata.*	KIMMERIDGE GROUP.
	Red ferruginous and yellow sandstones (Kuntkote Sandstone)* with *Steph. Maya, Pelt. perarmatum, Perisph. virguloides, leiocymon.*	? Zone of *Pelt. bimammatum.* ? Zone of *Pelt. transversarium.*	OXFORD GROUP.
CHAREE GROUP ...	Oolites (Dhosa Oolite) with *Steph. polyphemus, Perisph. Indo-germanus, Pelt. perarmatum, Arduennense, Babeanum*, etc.	Zone of *Amalth. cordatus* Zone of *Amalth. Lamberti.*	
	White limestones with *Pelt. athleta, Oppelia bicostata*, etc.	Zone of *Pelt. athleta.*	KELLOWAY GROUP.
	Shales with ferruginous nodules, with *Perisph. obtusicosta, anceps, Harp. lunula, punctatum*, etc.	Zone of *Perisph. anceps.*	
	Shales with calcareous banks and locally with golden Oolite with *Steph. macrocephalum, tumidum, bullatum, Oppelia subcostaria, Perisph. funatus, patina*, etc.	Zone of *Stephanoc. macrocephalum.*	
PUTCHUM GROUP ...	Light grey limestones and marls with *Oppelia serrigera*, Corals and Brachiopoda, etc.		BATH GROUP.
	Yellow sandstones and limestones with *Trigonia, Corbula, Cucullæa*, etc.		

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* The position of this sandstone is not thoroughly ascertained, as it is apparently entirely wanting in western Kutch. From palæontological reasons I assigned to it the above place, because it has the following species in common with the Dhosa Oolite: *Steph. Maya, opis, flexum, Peltoc. perarmatum.* The group of Kuntkote sandstones certainly includes the highest beds in which species of the genus *Stephanoceras* occur in Kutch.

CEPHALOPODA

OF THE

JURASSIC DEPOSITS OF KUTCH.

Order, DIBRANCHIATA.

Sub-order, DECAPODA.

(*A*) *Decapoda calciphora.*

Family, *BELEMNITIDÆ.*

BELEMNITES, *Agricola.*

The *Belemnites* are an important group of the Cephalopodous Mollusca both in a zoological and in a geological point of view. Though it is true that the separate species are not so strictly confined to separate horizons, as are most of the *Ammonites*, yet the groups commonly indicate with tolerable accuracy the different beds.

The difficulty of procuring perfect specimens of Belemnites is a great drawback in the study of this family; for, though fragments often indicate a distinct species, they are rarely sufficient for giving a description by which the species can again be recognised, if found perfect.

This is one of the reasons why, commonly, so few species of Belemnites are reported from beds in which Ammonites are most abundant in species. Another reason is the simple form of the guards on which the various changes in the organisation of the animal might not have become equally well marked, and thus we are often obliged to unite specimens into one species which, if the whole animal were procurable for examination, might very likely prove to belong to distinct forms.

Several systems have been proposed for the classification of the Belemnites, the best of which seems to be that of Charles Mayer, published in the *Journal de Conchiliologie* for 1863. However, as this system was suggested only to include the Jurassic Belemnites, while at that time several remarkable Cretaceous forms were not yet known to occur also in Jurassic layers, I have been obliged to make several additions to it in arranging the Kutch Belemnites, and thus I propose for the latter the following divisions:

GASTROCŒLI.

Section I.—CANALICULATI.

(*a.*) *Group of* BELEMNITES CANALICULATUS, Schloth.

(1.) Belemnites Kantkotensis, *Waagen*, n. sp.
(2.) „ orientalis, *Waagen*, n. sp.

(*b.*) *Group of* BELEMNITES BLAINVILLEI, Orb.

(1.) Belemnites, sp. indet.

Section II.—HASTATI.

(*a.*) *Group of* BEL. PISTILLIFORMIS, Blainv.

(1.) Belemnites claviger, *Waagen*, n. sp.

(*b.*) *Group of* BEL. DUVALIANUS, Orb.

(1.) Belemnites Katrolensis, *Waagen*, n. sp.
(2.) „ Sauvanausus, *Orb.*

(*c.*) *Group of* BELEMNITES HASTATUS, Blainv.

(1.) Belemnites fusticulus, *Waagen*, n. sp.
(2.) „ Stoliczkanus, *Waagen*, n. sp.
(3.) „ *cf.* hastatus, *Blainv.*
(4.) „ Jumarensis, *Waagen*, n. sp.

(*d.*) *Group of* BELEMNITES FUSIFORMIS, Parkinson.

(1.) Belemnites Gerardi, *Oppel.*
(2.) „ Calloviensis, *Oppel.*
(3.) „ subhastatus, *Ziet.*

NOTOCŒLI.

Section I.—CONOPHORI.

(*a.*) *Group of* BELEMNITES CONOPHORUS, *Opp.*

1. BELEMNITES OLDHAMIANUS, *Waagen*, n. sp.

We have, thus, from Kutch 14 species of Belemnites, most of which belong to the GASTROCŒLI, whilst the NOTOCŒLI are represented but by a single species. However, the occurrence of this is very remarkable, because in Europe the NOTOCŒLI are as yet known only from Tithonian and lower Cretaceous beds, while *Bel. Oldhamianus* is found in the upper Callovien, a little below *Pelt. athleta;*

an exception nevertheless, which is not so very uncommon in far distant geographical regions of one and the same geological period. The GASTROCŒLI have furnished 13 species, of which one is specifically undeterminable; the others are mostly new, but they do not exhibit anything very remarkable, except *Bel. claviger*, Waagen, which closely resembles certain well known cretaceous forms. Of greater interest are the species identical with European ones. They are—

Belemnites Sauvanausus, Orb.
" cf. *hastatus*, Blainv.
" *Calloviensis*, Opp.
" *subhastatus*, Ziet.

The first of these occurs in Kutch in the society of *Pelt. perarmatum* in the uppermost beds of the Charee group; and this fact is of high importance, because it is exactly the position in which the species is also found in Europe. The second species occurs pretty closely on or about the same horizon both in Europe and in Kutch; and although I have not been able to satisfy myself thoroughly of the identity of the species, little doubt exists on that point.

Bel. Calloviensis, Opp., is found in Kutch in beds immediately overlying the Macrocephalus beds, and in Europe it has a similar bathological position. The same applies to *Bel. subhastatus*, Ziet., which is characteristic for the beds with *Steph. macrocephalum* both in Kutch and in Europe.

Thus the jurassic Belemnites of Kutch, generally, confirm the law of succession of different forms as known in the European jurassic strata of corresponding age.

GASTROCŒLI.

Section I.—CANALICULATI.

(*a.*) *Group of* BEL. CANALICULATUS, *Schloth.*

1. BELEMNITES KUNTKOTENSIS, *Waagen*, n. sp., Plate I, Fig. 3, *a—f.*

This species is one of the most common Belemnites in the Kutch territory. Some excellent specimens were collected by Dr. Stoliczka at Kuntkote, and they principally serve as types for the description.

The shape of the guard is long, conical, or cylindrical, a little compressed from both sides in the upper or alveolar region. Lower down in the post-alveolar part this compression is not always well marked, and the transverse section of the guard here is more rounded or evenly depressed; but this latter case is very rare. The ventral side is provided with a long deep canal, which begins at the alveolar margin and reaches very nearly to the apex, here gradually becoming shallower and at last disappearing. The canal is deepest on the alveolar part of the guard; it is there narrow with rather sharp edges, as if it were cut in with a knife. As soon as the canal reaches the post-alveolar part, it becomes shallower and broader, being broadest about the middle of this part. In this character the Belemnite somewhat resembles certain species of the Russian Jura. The sides of the guard are smooth without any impressions; the back is rounded, with a very slight groove-like elongated impression in the alveolar region, stretching down from the alveolar margin about as far as the phragmocone inside the guard.

The phragmocone is rather long, acute, forming an angle of 22 degrees. It begins at its lower end with a roundish embryonal bulb, and is divided into very numerous air-chambers, which are about one-sixth of the diameter distant from each other. The septa are not quite level, but very slightly depressed at the siphonal side and a little elevated at the back. The sipho is very narrow, quite marginal, and in its position corresponds with the canal outside the guard.

The axis is a little eccentric, lying a little more towards the ventral side.

Very young specimens are somewhat hastate in shape, being slightly reduced in thickness just below the alveolar region, but this shape is lost again already at an early stage of growth.

The measurements are—

The total length of the described specimen	112	mm.
The length of the axis	78	„
Diameter at apex of phragmocone from front to back	12	„
„ „ „ from side to side	11	„

Remarks.—The examples which I have examined are very numerous, though only few entire specimens are among them; but even fragments are characteristic enough to be recognised as belonging to the present species. The localities at which the species occurs are:—Kuntkote, (about 20 specimens), out of a ferruginous sandy rock, together with *Steph. Maya* and other Ammonite-species of upper Oxfordian type; Gangta Bét, an island in the Run (about 15 specimens), out of a yellowish grey coarse sandstone, together with some of the same Ammonites as at Kuntkote; east of Lair, north base of Katrol range (5 specimens), out of the coarse iron-stained sandstone, with *Perisph. torquatus*, *Pottingeri*, and *Katrolensis*; village of Joorun (about 20 specimens), out of sandy concretionary layers at the base of the Katrol group; Lodai (2 specimens), out of yellowish sandstone of the same horizon; south of Bhooj (1 specimen), out of a coarse yellowish sandstone of the same horizon; south of Koora (about 10 specimens), out of shales, base of the Oomia group. Thus, the species ranges through the two upper divisions of the Kutch Jurassic formation, the Katrol and the Oomia groups, or, in other words, from the upper Oxford to about Lower Tithonian beds.

Belemn. Kuntkotensis has its nearest relation in *Bel. Aucklandicus*, Hauer.[*] The differences are slight, but sufficient to distinguish the species; they consist chiefly in *Bel. Aucklandicus*, being more cuneiform in its shape and having a broader and shorter canal, which does not extend so far down towards the apex, as it does in *Bel. Kuntkotensis*. Of other similar forms I may mention in the first place a Belemnite from Australia, of which Professor Phillips says: "It is not one of the Canaliculati, but more probably one of the Hastati," but which is figured on pl. XVI, fig. 7, as *Bel. canaliculatus* by Mr. Moore).* This Belemnite resembles in many respects our species, but by the equal width and the sharpness of its canal, it is easily distinguished from the latter. That the Australian species is not *Bel. canaliculatus* is pretty certain. From Southern Africa, Tate† describes a Belemnite under the name of *Bel. Africanus* of the canaliculate group. It is, however, very easy to recognise the differences of this from our species; they consist in the thick and clumsy shape and in the broad and short canal. From *Bel. canaliculatus* and its nearer allies, *Bel. Kuntkotensis* is easily separable by the shape of its canal, which becomes flatter and wider on the post-alveolar region.

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[*] Reise der österreich. Fregatte Novarra, Geolog. Theil, vol. I. Abth. 2, p. 99, pl. viii, figs. 2, 3.

Bel. Kuntkotensis represents, together with the following species, the group of *Bel. sulcatus*, (Mill.), Phill., in the Kutch Jura; both of them, however, differ from the one mentioned by a more central axis.

2. BELEMNITES ORIENTALIS, *Waagen*, n. sp., Plate I, Fig. 4, *a—d*.

Though this species is represented in our Museum only by one specimen, I do not hesitate to describe it under a new name, as the form is very characteristic and its geological position is of interest.

The form of the guard is strongly conical with nearly straight sides and a long, sharp apex. The section is nearly round, somewhat squarish at the alveolar extremity. At the ventral side of the guard a not very broad, sharply cut-in, groove is visible, which begins at the alveolar region and reaches nearly to the apex; it is very much like the groove in *Bel. sulcatus*, but a little longer. Sides and back of the guard are smooth without impressions or grooves.

The phragmocone is not well preserved; it seems to be rather short, and has an angle of 28 degrees. The sipho is marginal, very thin, and corresponds in its position with the groove outside. The apex of the phragmocone and the axis of the guard are very nearly central; the latter entirely straight.

The dimensions of the described specimen are—

Length	62	mm.
Diameter at apex of the phragmocone from side to side	15	„
„ „ „ from front to back	13	„
Length of the axis	55	„
From apex of phragmocone to the front...	6·5	„
„ „ to the back	6	„

Remarks.—The example, which has served for the above description, was found in a brownish Oolite at Wanda, where it occurs in the society of *Pelt. perarmatum* and several other lower Oxfordian species.

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* Quart. Journ. Geol. Soc., London, 1870, Vol. 26, p. 259

† *Ibid*. 1867, Vol. 23, p. 161, pl. VII, fig. 2.

Bel. orientalis is very nearly allied to *Bel. sulcatus*, Miller, as characterised by Professor Phillips; and the only important difference which induced me to separate the two forms, is the thoroughly central and straight axis in *Bel. orientalis*. All the other forms, belonging to the group of *Bel. canaliculatus*, are easily to be distinguished from our species by the shape of the canal or ventral groove.

If it were admissible to distinguish among the Belemnites similar developmental series, as among the Ammonites, the following species, *Bel. sulcatus*, *Bel. orientalis*, and *Bel. Kuntkotensis*, could constitute such a series, *Bel. sulcatus* being the oldest, or root-species.

(*b.*) *Group of* BEL. BLAINVILLEI, *Orb.*

1. BELEMNITES, sp. indet.

An apparently new species is indicated by a number of fragments consisting of upper and lower ends of the guard, pieces of the alveolar and post-alveolar region. The occurrence of these fragments in the same localities makes it very probable that all belong to one and the same species. The form of the guard appears to have been cylindrical, a little depressed from front to back. The ventral side is provided with a long canal, which begins as a very shallow and broad groove a short distance above the apex, becoming narrow already before it reaches the alveolar region, and disappearing again a little below the alveolar margin. Sides and back of the guard are smooth.

The phragmocone is tolerably long and pointed, enclosed in an angle of 15 degrees. The siphon is marginal, very narrow, and corresponding to the canal outside; the septa are one-fifth of the diameter distant from each other.

The species seems to become very large, as one specimen from Gangta Bét measures 25 mm. in diameter.

Remarks.—Fragments of the species are preserved in our Museum from three localities; Gangta Bét; east of Lair in the Katrol range; and south-east of Mankoa in the Charwar range: at the two last places occurring with certainty in the Katrol group.

The specimens show the nearest affinities to *Bel. Volgensis* or *absolutus* of the Russian Jura, but it seems impossible from the fragments to point out exactly the identity with, or the affinity to, those species.

Section II.—HASTATI.

(*a.*) *Group of* BEL. PISTILLIFORMIS, *Blainv.*

1. BELEMNITES CLAVIGER, *Waagen*, n. sp., Plate II, Fig. 2, *a—f*.

It seems very difficult to obtain perfect specimens of this species, a difficulty which is common to the whole group, for of *Bel. pistilliformis* itself specimens with the alveolar region preserved are also very rare. Thus, I cannot in the present instance state whether in *Bel. claviger* the alveolar part of the guard possesses a canal or not.

As far as preserved, the guard is long, strongly pistilliform, with a rather short, slightly mucronate apex. Its section is roundish in the lower part of the post-alveolar region, and squarish in the thin upper end of it; the ventral side there is flattened with a slight longitudinal impression, the sides are also pressed in and a little excavated, the back is rounded. Farther down, very distinct vascular impressions extend along the sides of the guard.

The dimensions of the best preserved specimen are—

Length of the post-alveolar region	110 mm.
Diameter at upper end of it from front to back	6·5 „
„ „ from side to side	7 „
„ of the rounded lower third of the post-alveolar region	16 „

Remarks.—Nowhere in Europe have any layers of the Jura formation as yet furnished Belemnites of the group of *Bel. pistilliformis*, and it is, therefore, very interesting to find forms of this group here in India associated with true and well known European Jurassic species. This clearly indicates how careful it is necessary to be when comparing rocks of distant countries from solitary, not identical, but only allied species. *Bel. claviger*, if found alone, would, from analogy, certainly be very easily taken as indicating cretaceous beds, whilst in reality it is of upper jurassic, (very likely Kimmeridgian,) age. Only a series of partly identical, partly analogous species can give an exact idea of the geological horizon of a given deposit.

Our species is very nearly allied to *Bel. pistilliformis*, Blainv., and the only important differences between the two consist in the upper end of the post-alveolar region, which is squarish in *Bel. claviger* and round in Blainville's species.

Specimens, mostly more or less extensive fragments, have been collected in the bed of the Bothor river, near Jurun, in a hard yellowish sandstone altered by the contact with basalt (one very good specimen); south of Lodai, in sandy shales above *Pelt. perarmatum*, (one nearly entire specimen and several large fragments); south of Jurun in soft sandy shales, at the village itself, in sandy concretionary beds, and east-south-east of this place again in soft shales; south of Boojoorie in dark red ferruginous sandstone; at all those localities it is found in the Katrol group.

At other places bad fragments were collected, which I can only doubtfully refer to this species. They come from south-west of Nurrha, out of a sandy bank of the Katrol group; from north-east of Goonari, out of yellow sandstone; and from north of Moondan, out of an oolitic layer: the two last localities are in the Oomia group.

(*b.*) *Group of* BEL. DUVALIANUS, *Orb.*

1. BELEMNITES KATROLENSIS, *Waagen*, n. sp., Plate II, Figs. 7, 8, 9.

The Belemnite to which I give this name is extremely characteristic for certain divisions of the Kutch Jura; and as its form is easily recognised, the species is of great value for the geology of Kutch.

The guard is rather short, cylindrical, perfectly round in section, or very slightly compressed from both sides, with nearly parallel sides, tapering gradually towards the apex. At the ventral side there is a short, rather narrow groove, or canal, which begins at the alveolar margin and terminates at the beginning of the post-alveolar region. On the sides of the guard are, in well preserved specimens, slight vascular impressions; the back is smooth.

The phragmocone is round, not quite straight, forming an angle of 19·5 degrees. It begins at its apex with a small embryonal bulb and has not very numerous septa, which are a little more than one-fifth of the diameter distant from each other. The siphon is marginal, very thin, and corresponding with the canal outside. The axis is straight and very nearly central, just perceptibly shifted towards the ventral side.

The dimensions of various specimens are—

	1.	2.	3.	
Total length of the guard	79	82	79	mm.
Diameter at the alveolar margin from back to front	14	13	12	„
„ „ „ from side to side	14	12	11·5	„
Distance of end of the canal from apex	45	49	45	„

Remarks.—The localities are numerous at which *Bel. Katrolensis* has been met with:—Katrol range, east, west, and south of Lair, 12 well preserved specimens, in a greyish-yellow iron-stained coarse sandstone; at Lodai, in soft grey shales, 3 excellent specimens; at north of Dhosa, in a soft sandy calcareous bed, 1 specimen; from a soft sandy shale east of Rodur, 8 fragments; in a coarse sandstone south of Bhooj, many fragments; 2 well preserved specimens, in sandy calcareous beds north-west of Jikli. All these are out of the Katrol group; the species, however, seems to go yet higher, in the Oomia group; at least, I cannot distinguish some fragments which were collected by Dr. Stoliczka out of this group in the middle of the large hill next to Katrol hill.

The only species with which our species is somewhat closely allied is *Bel. Sauvanausus*, Orb. Both forms decidedly belong to the same developmental series. However, there are certain differences which lead me to consider both as different species. The form of *Bel. Katrolensis* is cylindrical, instead of hastate; the apex is gradually tapering to a point, and not mucronate; and the canal is shorter than in *Sauvanausus*.

The species is, speaking geologically, the youngest form as yet known of the group of *Bel. Duvalianus*.

2. BELEMNITES SAUVANAUSUS, *Orb.*, Plate II, Fig. 6, *a—f*.

1843. *Bel. Sauvanausus*, Orbigny, Paléont. Franç. Terr. Jurass., I, p. 128, (pars) pl. 21, figs. 1—3 and 6—10.
1863. „ „ „ Ch. Mayer, Journ. de Conch., Avril, 1863.
1866. „ „ „ Oppel, Zone des *A. transversarius*, Benecke's Geognost. Palæontol. Beitr., II, p. 215.

The species, though described by D'Orbigny long ago, was comparatively rarely found and mentioned in European Jurassic beds, as it belongs there almost exclusively to the Mediterranean Province, which, until very lately, was but little studied.

The guard is short, hastate in shape, roundish in its section, with a slight ventral depression, and on the ventral side with a sharp, rather deep, but not very broad canal or groove, which occupies more than half of the length of the guard and begins at the alveolar margin. Down the sides run vascular impressions; the back is smooth, rounded. In the specimens from Kutch, the protracted mucronate apex is commonly worn off.

The phragmocone is long and rather acute, possessing an angle of 19 degrees, beginning at its lower end with a round embryonal bulb. The septa are not very numerous, being about one quarter of the diameter distant from each other. The siphon is marginal, very thin, and in its position corresponds with the canal outside the guard. The shell of the phragmocone shows very clearly the fine striation, differing from the general type in the asymptotes, which are two deeply impressed lines stretching along near the dorsal region, the arches there being very flat and depressed. The hyperbolar region is composed of fine straight lines, running up nearly vertical.

The axis is very nearly central, shifted, however, a little towards the back.

The dimensions of a specimen are—

Total length of guard	67	mm.
Diameter near apex of phragmocone from back to front	11	„
„ „ „ from side to side	12	„
„ at alveolar margin from back to front	10	„
„ „ „ from side to side	10·5	„
Distance of end of canal from apex	31	„

Remarks.—The species is not very rare in the Kutch Jura. It was found, south-west of Lodai, in sandy shale, (6 specimens, 2 of them entire, the others fragments); at Wanda, many fragments in soft shales; south of Samtra, some fragments in soft shales; north-west of Jumara, 3 specimens in a dark iron-oolite; from north-west of Kumagoona in shales (2 fragments). At all those localities, the species is found in thin shaly bands between and below the oolites with *Pelt. perarmatum* in the uppermost beds of the Charee group.

Bel. Sauvanausus can easily be distinguished from *B. Katrolensis*, the nearest allied species, by its hastate shape, the longer canal, and the more finely pointed apex.

(*c.*) *Group of* BEL. HASTATUS, *Blainv.*

1. BELEMNITES FUSTICULUS, *Waagen*, n. sp., Plate I, Fig. 2, *a—e.*

Though only one specimen of this species is preserved in our Museum, it deserves to have a name given to it, as its form is very characteristic, and the resemblance to some not yet described species of the Alpine Jura of Europe very great.

The guard is very elongated, cylindrical, or very slightly hastate, the sides gradually tapering towards the slender and very elongated apex. On the former part of the guard, a little behind the alveolar region, there is a short, not very broad or deep canal, which does not extend farther than the former third of the whole guard. It is doubtful if this canal is a ventral or a dorsal one, as on the single specimen I have for description the greater part of the alveolar region is wanting, and thus the position of the sipho is uncertain; I believe, however, from the relations of this species to others, that the canal is ventral. The sides of the guard show rather strong, straight, vascular impressions, the back is smooth and rounded. The transversal section is squarish in the former, rounded with a flattened ventral side in the middle part of the guard, and entirely rounded near the apex. The apical line or axis is central.

The alveolar region is broken away just at the beginning of the phragmocone.

The dimensions of the described specimen are the following:—

Length of the post-alveolar region	195	mm.
Diameter at beginning of it from back to front	9	„
„ „ „ from side to side	9·5	„
„ at upper third of post-alveolar region near end of canal from back to front ...	11	„
„ „ „ „ „ from side to side ...	12	„
Distance of end of canal from the apex, about	130	„

Remarks.—The only specimen existing of this species is from the dark-red, sandy ferruginous rock of Kuntkote, together with *Ammonites* of middle Oxfordian types.

The species is apparently very nearly allied to *Bel. baculoides*, Ooster,[*] at least to the variety shown in his pl. 2, figs. 3, 4, which evidently represents a species different from that shown in figs. 1 and 2, but the shorter canal, the depression of the guard on the ventral side, and the strong vascular impressions on its sides, distinguish *Bel. fusticulus* from Ooster's species.

2. Bel. Stoliczkanus, *Waagen*, n. sp., Plate I, Fig. 1, *a—f.*

This species represents in the Kutch Jura *Bel. unicanaliculatus*, Ziet., or *Bel. semisulcatus*, Münst.

The guard is very long, elongate, hastate, with a roundish section, a little depressed on the ventral side, principally in the middle of the post-alveolar region. Along the ventral side there is a deep and rather broad canal, which is, however, comparatively very short, because it does not reach quite so far down as the first third of the post-alveolar region, and vanishes here in a plain ventral depression of the guard.

The sides show very slight vascular impressions, and sometimes they are barely perceptibly flattened. The back is regularly rounded; apex very elongated; axis central.

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[*] Ooster: Catalogue des Cephalopodes des Alpes Suisses, Neue Denkschr. der Schweiz. Naturf. Ges., Vol. 17, 1860.

The phragmocone is rather short, straight, not very acute, having an angle of 19 to 19·5 degrees. Its section is entirely rounded, the septa are not very numerous, about one quarter of the diameter distant from each other. The siphon is marginal, thin, and corresponding in position to the canal outside.

The dimensions of the described specimen are—

Total length of guard	168	mm.
Length of axis	160	„
Diameter at end of alveolar region from back to front	14	„
„ „ „ „ from side to side	12	„
„ in the lower half of the post-alveolar region from back to front	15	„
„ „ „ „ „ „ from side to side	16·5	„
Distance of lower end of canal from apex, about	115	„

Remarks.—The specimens, which have served for description, are two nearly perfect ones, and several fragments collected by Dr. Stoliczka in the ferruginous sandy beds of Kuntkote in Wagur, together with the foregoing species and Ammonites of upper Oxfordian types. No specimens are known from other localities.

The species exhibits a very great resemblance to *Bel. unicanaliculatus,* Zieten, a European species of Oxfordian and Kimmeridgian age; but the general form of *Bel. Stoliczkanus* is more elongate, the canal shorter and less sharp. These characteristics are yet much more apparent when we compare our species with *Bel. hastatus,* Blainv. Another species which might be mistaken for the Kutch fossil is one figured by Ooster on pl. 2, figs. 1, 2 (non 3, 4), under the designation of *Bel. baculoides,* but this has the canal much longer and the apex quite different in shape from the Kutch form.

The relation to *Bel. unicanaliculatus,* Ziet., is of high interest, principally when we consider at the same time the Ammonite fauna, in which *Perisph. leiocymon,* Waag., corresponds with *Per. polyplocus,* Rein., and *Per. virguloides,* Waag., with *Per. virgulatus,* Quenst. As the number of species identical with those from the European Jura is very small in the Kuntkote beds, those analogies help much towards the determination of the age of those beds, and we thus come to the conclusion that the Kuntkote beds are very likely of upper Oxfordian age.

3. BELEMNITES *cf.* HASTATUS, *Blainv.*

1827. *Belemnites hastatus,* Blainville, Belemn., p. 71, pl. 1, fig. 4, pl. 2, fig. 4, pl. 5, fig. 3.
1842. , „ (Blainv.), Orbigny, Pal. Franç. Terr. Jurass., Vol. I, p. 121 (pars), pl. 18.
1848. „ *semihastatus rotundus,* Quenstedt, Cephalop., p. 440, pl. 29, fig. 8.
1857. „ *hastatus,* (Blainv.) Oppel, Juraform., p. 546.

Out of a great many fragments I find only the upper and lower ends preserved, but they cannot be referred to any other species than *Bel. hastatus.* However, to prevent a possible mistake that might occur in the identification, I record these fragments merely under the name of *Bel.* cf. *hastatus.*

Among those fragments the lower ends of the guards are more or less cylindrical, rounded in section and smooth, with not very distinct vascular impressions along the sides; the apex is somewhat mucronate. The upper ends are rather thin, also with a rounded section and a deep, not very broad canal along the ventral side. Some of the lower ends show yet the end of the canal.

The phragmocone is usually a little shorter than in *Bel. hastatus*, and possesses an angle of 20 to 21 degrees.

The dimensions of the species seem not to have exceeded the size of Quenstedt's figure.

Fragments of the species are preserved in our Museum from the following localities and layers:—North-east of Gudjinsir, out of black shales; east of Nurrha, out of gray shales; south of Keera hill, near Charee, out of yellowish-gray shales. At all these localities the species occurs together with *Pelt. athleta* or other Ammonites belonging to this horizon. At other places: Lodai, (Oolite); north-west of Jara, (in Oolite); south of Barasir (in shales); it is found somewhat higher in the society of *Pelt. perarmatum*.

At one locality, Wanda, Dr. Stoliczka collected the species in somewhat lower beds, below *Pelt. athleta* and with *Perisph. obtusicosta*.

The best specimens were found by Mr. Wynne in the Oolite at Lodai.

4. BELEMNITES JUMARENSIS, *Waagen*, n. sp., Plate II, Fig. 5, *a—d*.

A very nice little species of the hastate group.

The guard is beautifully fusiform in its shape, with very thin upper end and perfectly round section. The ventral side of the post-alveolar region is provided with a fine, narrow, not very deep groove, which occupies about half the length of it. The vascular impressions at the sides of the guard are very faint, barely perceptible; the back is smooth and rounded; the apex is not very pointed; axis straight and central.

The phragmocone is not preserved in the specimen I have for description.

The dimensions of the only preserved post-alveolar region of the species are—

Total length	68 mm.
Diameter at upper end of post-alveolar region from back to front	4·5 „
„ „ „ „ from side to side	4 „
„ at the lower third of post-alveolar region from back to front	8 „
„ „ „ „ from side to side	8·5 „
Distance of end of canal from the apex	36 „

Remarks.—The species is founded upon a single specimen, which was collected by Dr. Stoliczka together with *Bel. subhastatus* in the Macrocephalus beds at Jumara; other fragments from the Macrocephalus beds of north-west of Jara may possibly belong to the same species.

Bel. Jumarensis is very nearly allied to *Bel. hastatus*, Blainv., and is in fact the præcursorial form of this species. There are, however, certain marked differences between the two. In *Jumarensis*, the general shape is much less hastate, but rather fusiform. The section of the guard is thoroughly rounded, whilst in *Bel. hastatus*, the section is always more or less depressed and a little squarish; the upper end is extremely thin, the canal fine and comparatively short, the vascular impressions at the sides of the guard are very faint, barely perceptible; in all these points, the contrary is the case in *Bel. hastatus*.

Thus, *Bel. Jumarensis* may fairly be considered as distinct, and it is the first and oldest representative of the true HASTATI, occurring in Kutch in typical Macrocephalus beds.

(*d.*) *Group of* BELEMNITES FUSIFORMIS, *Parkinson.*

1. BELEMNITES GERARDI, *Oppel*, Plate II, Fig. 3.

1865. *Belemnites Gerardi*, Oppel: Palæontolog. Mittheil., p. 296, pl. 88, figs. 1—3.

The species is represented mostly by fragments in our Museum, but even those are so characteristic that it is easy to recognize the form.

The guard is short, cylindrical, or slightly hastate, rather broad, roundish in section near the alveolar margin, depressed in the greater part of the post-alveolar part. The ventral side is provided with a very deep and broad canal, which begins near the apex and reaches the alveolar margin; it is broadest in the middle part of the post-alveolar region. The back is flatly rounded, the sides nearly smooth, with extremely faint vascular impressions, gradually tapering towards the elongated apex.

The phragmocone is rather short, commonly a little compressed, straight, showing an angle of 24 to 28 degrees, its apex being central or very nearly so. The siphon is marginal, thin, and in its position corresponds to the canal outside the guard. The axis is central at its beginning, but becomes a little excentric at about the middle of the post-alveolar part; it is shifted towards the ventral side.

The dimensions are—

Total length of the guard, about ... —	?83	mm.
Diameter a little below alveolar margin from back to front	11·5	„
„ „ „ „ from side to side	12	„
„ at the beginning of post-alveolar region from back to front — ...	11	„
„ „ „ „ from side to side	12	„

Remarks.—The localities at which *Belemnites Gerardi* occurs in Kutch are numerous. It has been found south of Samtra, in sandy shales; west side of Keera hill, in the highest beds of Oolite; at Wanda, in shales; south-west of Barasir, in black shales; south-east of Nurrha; south-east of Kagnora, in shales, the lowest beds exposed in Wagur; north-west of Kumaguna, in shales; from south-west of Lodai, in yellow sandy shales.

From this list it appears that the species has a rather extensive distribution, horizontal as well as vertical. It is entirely wanting in the true Macrocephalus beds, but begins immediately above it, and extends from here through the whole upper part of the Charee group; in other words, it is found in upper Callovian and lower Oxfordian beds.

Bel. Gerardi is very nearly allied to *Bel. Kuntkotensis*, but easily distinguishable by the faint vascular impressions along the sides of the guard, which determine the position of our species in the hastate group. From *Bel. subhastatus*, Ziet., it differs by the less hastate shape and the more roundish section of the guard; the same characteristics easily separate it from *Bel. Calloviensis*, Opp.

2. BELEMNITES CALLOVIENSIS, *Oppel*, Plate II, Fig. 4, *a—d*.

1848. *Belemnites semihastatus depressus*, Quenstedt, Cephalop., p. 440, pl. 29, figs. 12—19.
1857. *Belemnites Calloviensis*, Oppel, Juraform., p. 546.

The description and figure of this species by Quenstedt are excellent and need but few additions.

The guard is rather long and hastate in shape, strongly depressed, with a broad deep canal on the ventral side, which, however, becomes finer in the alveolar region, and reaches down until within a short distance of the apex. The vascular impressions along the sides of the guard are very faint, the back rounded.

The phragmocone is tolerably long, but not very acute, enclosing an angle of about 25°. The septa are very numerous, only about $\frac{1}{8}$th of the diameter distant from each other. The siphon is thin, marginal, and corresponding to the canal outside the guard.

The dimensions are—

Total length of guard, about	90	mm.
Length of axis, about	73	„
Diameter at apex of phragmocone from back to front	6	„
„ „ „ from side to side	7	„
„ middle of post-alveolar region from back to front	7	„
„ „ „ „ from side to side	9	„

Remarks.—Bel. Calloviensis is not very common in the Kutch Jura. The species is found in thin-bedded Oolites or shaly limestones immediately above the true *Steph. macrocephalum*, and has in these beds been found north of Kumaguna and on the Keera hill near Charee.

3. BELEMNITES SUBHASTATUS, *Zieten*, Plate II, Fig. 1, *a—e*.

1832. *Belemnites subhastatus*, Zieten, Verst. Württemb., p. 27, pl. 21, fig. 2.
1840. „ *canaliculatus*, Schloth., Sowerby, Trans. Geol. Soc., Lond., Vol. V, pl. xxiii, fig. 2, and expl.
1850. „ *Grantanus*, Orbigny, Prodrome, I, p. 326.
1857. „ *subhastatus* Ziet., Oppel, Juraform., p. 546.

Zieten's figure of this species is unfortunately so bad that it is very difficult to recognise the exact form which is generally understood under the name of *Bel. subhastatus*. A short remark by Oppel, who says in his Juraformation that the species is intermediate in its form between *Bel. canaliculatus*, Schloth., and *Bel. Calloviensis*, Opp., appears to be more reliable.

The guard is rather long, very little hastate, strongly depressed, with a moderately elongated apex. The ventral side is occupied by a strong, broad, somewhat flattened canal, which reaches nearly to the apex, and gets very little narrower in the alveolar region. The sides of the guard are narrowly rounded, and show only in very well preserved specimens vascular impressions. The back is broadly rounded, rather flat.

The phragmocone is not very long, straight, acute, exhibiting an angle of 20°, its apex is not central, but shifted towards the ventral side. The septa are numerous, about one-fifth of the diameter distant from each other, the siphon corresponding in its position with the canal outside.

The measurements of some specimens are:

	1.	2.	3.
Total length of guard	98 mm.	80 mm.	83 mm.
Length of axis	? ,,	60 ,,	(?) ,,
Diameter at alveolar margin from front to back	12 ,,	11 ,,	8·5 ,,
,, ,, ,, ,, from side to side	12 ,,	11·5 ,,	10 ,,
,, ,, middle of postalveolar region from front to back ...	11 ,,	11 ,,	8 ,,
,, ,, ,, ,, ,, from side to side ...	14·5 ,,	13·5 ,,	11 ,,

Remarks.—Bel. subhastatus is not very common in the Kutch Jura, and is apparently restricted to the beds with *Steph. macrocephalum.* The species was collected by Dr. Stoliczka in those beds north of Soorka in oolite; on the way between Kumaguna and Urira, also in oolite; north-west of Jumara, in flaggy oolitic limestone, and north of Deysulpoor, in calcareous shales. The locality at Keera hill near Charee has furnished only fragments, some of which seem to belong to this species.

Belemnites Grantanus, Orb., is to be considered a synonym of the European species, as Sowerby's figure, upon which the species is founded, represents nothing but a lower end of *Bel. subhastatus.*

Zieten's species is rather difficult to distinguish from *Bel. calloviensis,* Oppel, except by the greater thickness of the alveolar and of the beginning of the postalveolar region, the result being expressed in the less hastate shape of the specimens. In Europe, *Bel. subhastatus* is also one of the most characteristic species of the Macrocephalus beds.

NOTOCŒLI.

Section I.—CONOPHORI.

(*a.*) *Group of* BELEMNITES CONOPHORUS, Oppel.

1. BELEMNITES OLDHAMIANUS, *Waagen*, n. sp., Plate I, figs. 5, 6.

Several specimens of a small canaliculate Belemnite, which at the first glance much resembled *Bel. Argovianus,* Ch. Mayer, were collected by Dr. Stoliczka in certain beds of the Kutch Jura, but on closer examination they proved to belong to the division of the *Notocœli* of Bronn.

The guard is very short, cylindrical, or slightly hastate, squarish, rounded in section, and on the back provided in the alveolar region with a short and narrow, but very deep canal, so much so that it nearly, as in *Belemnitella*, reaches the phragmocone. The apex is short and somewhat mucronate. The sides of the guard are slightly flattened, sometimes with indistinct vascular impressions; the ventral side is smooth, broad and flattened, broader than the back.

The phragmocone is rather long in comparison to the length of the guard, straight, showing an angle of 24°, its apex being thoroughly central. The siphon is marginal, not very thin, and in its position opposite to the canal outside the guard. The shell of the phragmocone exhibits in some specimens clearly the characteristic stripes, which in all Belemnites cover it; but as was first observed by Quenstedt[*] on *Bel. dilatatus*, the arched region, or back, corresponds with the canal of the guard, whilst the horizontal stripes with the sipho in the middle under the same lie opposite, corresponding with the smooth and flat ventral side of the guard.

The dimensions of the specimens are:

	1.	2.
Total length of guard	38 mm.	44 mm.
Length of axis	21 „	33 „
Diameter at end of alveolar region from back to front	10·5 „	12 „
„ „ „ „ from side to side	12 „	13·5 „

Remarks.—The species just described is of high geological interest, because it shows, that forms of the division of the NOTOCŒLI occur in much older beds than was believed only a short time ago.

Only three specimens have been found, proving that the species must be very scarce in Kutch. One of them is from a black shale south-east of Nurrha, from a bed a little below *Pelt. athleta;* the second specimen was found at Keera hill near Charí in the same geological position together with *Perisph. arthriticus*, in soft yellowish shales; the third specimen is from south of Samtra, also out of shales; it was collected there together with another thick short Belemnite, which is very likely a deformity of our species.

The nearest allied species is *Bel. conophorus*, Oppel, which is, however, distinguishable from *Bel. Oldhamianus* by its less deep canal and round section. In shape, *Bel. Argovianus* is also very much like our species, but it was placed by Ch. Mayer, who described it first, in the group of *Bel. Ducalianus*, and thus belongs to an entirely different division of Belemnites.

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[*] Quenstedt, Cephalop, p. 449, pl. 30, fig. 8.

Family.—NAUTILIDÆ.

Genus.—NAUTILUS.

The very remarkable constancy of form in the species belonging to this genus produces such a uniformity in the mesozoic Nautili, that only comparatively minute differences can be used to characterise single species. Nevertheless the number of carefully distinguished species is being added to daily, and it is of great interest to observe how the increasing knowledge of this group also serves to confirm the common law of the development in time of organic beings. Thus, there is, for instance, a very clear developmental connection between *Naut. lineatus*, Sow., *Naut. calloviensis*, Opp., and *Naut. Wandaensis*, Waagen, and no doubt many other forms will prove to stand in similar relation to each other, as soon as the intermediate forms of the series may be found. But Nautili are not very common in mesozoic formations, excepting a few species, and thus our knowledge regarding them increases but slowly.

On the other hand, we cannot expect to find in every bed a distinct species, and must treat the Nautili in this respect very much like the Belemnites, allowing for single species a rather extensive vertical occurrence. Here, as in the Belemnites, this may depend partly upon the simplicity of the form of the Nautilus shell, which does not admit of more minute distinctions, partly, however, it seems also to have its reason in the greater power of resistance in the animal against the influences of outer conditions.

Of all the six species of Nautili found in the Kutch Jura and described hereafter, only one is identical with a European form, *Nautilus calloviensis*, Oppel.

All the others are new species, one of them principally interesting on account of its ornamentation. *Naut. calloviensis* is in India found in beds having exactly the same relations as in Europe, *viz.*, in the beds with *Steph. macrocephalum.*

(*a.*) *Group of* NAUTILUS LINEATUS, *Sow.*

1. NAUTILUS WANDAENSIS, *Waagen*, n. sp., Plate IV, fig. 3, *a—b.*

A rather thick species, with obtusely angular whorls. Though the shell is preserved in the specimen from Wanda, it is so much worn that it cannot be seen whether it was concentrically striped or not.

The umbilicus is rather wide, being about one-eighth of the diameter, with perpendicular walls, which are even a little turned inside near the suture. The greatest thickness of the shell is on the umbilical margin; from here the sides slope down towards the external part, which is considerably flattened, with obtuse edges on both sides. The septa are simply curved, a little cut out at the external side. The position of the sipho is not visible.

The dimensions of the two preserved specimens are :

	I.	II.
Diameter of the shell	37 mm.	85 mm.
„ of the umbilicus	6 „	11 „
Thickness of the shell	23 „	60 „
Height of the last whorl from the umbilicus	19 „	45 „
„ „ „ „ from the preceding whorl	16 „	34 „

Remarks.—The description is founded on two specimens, of which one was found in dark oolite, north-west of Soorka, the other, also in oolite, near Wanda; at both localities they occurred in the society of *Pelt. peramatum.*

Naut. wandaensis is very nearly allied to *Naut. calloviensis*, Opp., but can be easily distinguished by its much larger umbilicus.

2. NAUTILUS CALLOVIENSIS, *Oppel.*, Plate III, fig. 2, *a,—b.*

1840. *Nautilus hexagonus ?* Sow. Transact. Geol. Soc., Lond., Vol. V, pl. 23, f. 4 and expl.
1842. *Nautilus hexagonus* (Sow.), Orbigny, Pal. Franç. Terr. Jurass., Vol. I, p. 161, pl. 35, figs. 1-2, (*non* Sow., Min. Conch).
1857. *Nautilus calloviensis*, Oppel, Juraform., p. 347.

This species seems rather common in Kutch; it is certainly the most common species of all the Nautili there.

The general form of the shell is smooth, not very thick, with a small umbilicus and somewhat angulate whorls. The umbilicus is only about one-thirteenth of the diameter deep, and with walls which are turned a little inside. The greatest thickness of the shell is at the umbilical margin; from there the flattened sides slope towards the external part, which also is flattened, and provided on each side with a very obtuse ridge. The shell itself is covered with two systems of fine striæ, of which the parallel ones, which follow the direction of the spiral, are limited to the external part of the shell. The others,– striæ of growth,– cover the whole shell, are somewhat falciform on the sides, but bend strongly backward on the external part. On very large specimens those lines become very strong, numerous, and look as if cut in with a knife; the other system of striæ then entirely disappears.

The septa are simply curved, a little cut out at the external part. The sipho is tolerably thick, and has its position in the outer third of the septum.

On the cast the normal line is often very strongly pronounced.

The dimensions of a specimen from north-west of Jumara are:

Diameter of the shell	65	mm.
„ of the umbilicus	4·5	„
Thickness of the shell	41·0	„
Height of the last whorl from the umbilicus	39·0	„
„ „ „ „ from the preceding whorl	25·0	„

Remarks.—The species is represented in our collection by five specimens, two of which were found in the golden oolite at Keera hill near Charí, one north-west of

Jumara in yellowish-gray limestone, and two north-west of Soorka in ferruginous concretions out of shales. The latter two are only body chambers, the one of which has, though compressed, a diameter from one side to the other of more than 90 mm. This shows how large the species did grow. All the specimens at the different localities were found in the society of *Steph. macrocephalum.*

Naut. calloviënsis is very nearly allied to *Naut. lineatus*, Sow., but the differences have been already very well pointed out by Orbigny. From *Naut. wandaensis* the species is distinguishable by its smaller umbilicus. The differences from *Naut. hexagonus*, Sow., Min. Conch., were already well observed by Sowerby himself in his paper on the Kutch fossils; however, he united the Kutch-form, though with some doubt, with his former species.

(*b.*) *Group of* NAUTILUS HEXAGONUS, *Sow.*

1. NAUTILUS KUMAGUNENSIS, *Waagen*, n. sp., Plate III, fig. 1, *a—b*.

A rare species of the general form of *Naut. hexagonus*, Sow. The shell is narrowly umbilicated, rapidly increasing in height, and very likely becoming nearly as large as *Naut. giganteus*, Orb., which is a synonym of Sowerby's *Naut. hexagonus.*

The umbilicus is not very wide in this species, and not more than about one-tenth of the diameter. It is very deep, with perpendicular walls, a little turned in near the suture. The greatest thickness of the shell is at the umbilical margin; from there the flattened sides slope towards the external part. This latter is slightly excavated, with a somewhat prominent, rounded obtuse ridge on each side. The shell is nearly entirely smooth, only with extremely faint striæ of growth.

The septa are simply curved, but strongly cut out on the external side; the sipho is not preserved in the specimens I have for description.

The dimensions of the described specimen are:

Diameter of the shell	72	mm.
„ of the umbilicus	6·5	„
Thickness of the shell	48	„
Height of the last whorl from the umbilicus	40	„
„ „ „ „ from the preceding whorl	31	„

Remarks.—The only entire specimen is preserved in an iron nodule out of shales belonging to the beds of *Steph. macrocephalum*, north of Kumaguna. A fragment preserved in very fine brown oolite of Lodai seems to come out of the middle of the Charí group.

The species is nearly allied to *Naut. hexagonus*, Sow., but easily distinguishable from it by the smaller umbilicus and the less prominent ridges on the external angles.

(*c.*) *Group of* Nautilus subinflatus, *Orbigny.*

1. Nautilus intumescens, *Waagen*, n. sp., Plate III, fig. 3, *a—b.*

A shell, of about the size of *Naut. pompilius.* It is of a thick inflated form, without umbilicus, if well preserved, as this part is then entirely covered by a thick shelly callosity, as in the living Nautilus. If the shell is destroyed, a tolerably wide umbilicus becomes visible.

The shell itself is very thick, and nearly entirely smooth, only on a few places extremely fine striæ of growth can be observed. The cast looks much more slender than when the specimen is covered with shell, and the appearance of an umbilicus gives to it quite a different aspect. The umbilicus is then a little less than one-eighth of the whole diameter of the cast, is very deep, and has perpendicular walls. The greatest transversal diameter lies a little above the umbilical margin; from there the sides slope slowly towards the perfectly rounded external part, in the middle of which the normal line is on casts sometimes slightly indicated.

The septa are simply curved, making a very shallow lobe on the external side. The sipho is not preserved.

The dimensions of a specimen from north-west of Jumara are:

Diameter of the shell	112 mm.
„ of the umbilicus	12 „
Thickness of the shell	85 „
Height of the last whorl from the umbilicus	68 „
„ „ „ „ from the preceding whorl	51 „

Remarks.—The specimen I have for description is out of a gray somewhat ferruginous limestone from north-west of Jumara, where it was found in the society of *Steph. macrocephalum.*

Of the species of Nautili as yet described, only *Naut. subinflatus*, Orbigny, out of the Kimmeridge clay of Honfleur, etc., seems to show a certain relation to the Indian species, but it is unknown, if the former, when provided with shell, has its umbilicus closed with a callosity. Even *Naut. pompilius*, Linn., is much allied to *Naut. intumescens;* however, the former has more strongly curved septa. It is very strange to find in Kutch in jurassic beds a species which has its nearest relations among the living world. What may have been the reason that *Nautilus* was able to endure all the changes of so many geological periods without having been very sensibly affected by them?

(*d.*) *Group of* Nautilus aganiticus, *Schloth.*

(1). Nautilus Kutchensis, *Waagen*, n. sp., Plate III, fig. 4, *a—b.*

The species seems very rare in the Kutch Jura.

The form of the shell is rather thick, with flattened sides, angular externally, and with a small umbilicus. The latter is deep, with sloping walls, a consequence of the umbilical edge being not very sharp; its diameter is one-eleventh of the diameter of the shell. The section of the whorls is somewhat rectangular, with flattened sides, flattened external part, and the greatest thickness near the umbilicus.

The septa are strongly curved with an obtuse saddle near the umbilicus, a not very deep rounded lobe on the sides of the shell, and also a rather strong excavation on the external part. The sipho pierces the septum in its outer fourth.

The shell itself is not preserved on the specimen I have for description.

The dimensions are:

Diameter of the shell	47	mm.
„ of the umbilicus	5	„
Thickness of the shell	27	„
Height of the last whorl from the umbilicus	28	„
„ „ „ from the preceding whorl	18	„

Remarks.—The species has been found in a brown iron-stained oolite, in the middle of the Charí group (beds with *Perisph. arthriticus*, Sow.) at Wanda, in only one specimen.

It is very nearly allied to *Naut. aganiticus*, Schloth., but has its sipho nearer to the external side. *Naut. biangulatus*, Orb., also resembles very much the Kutch species, but is distinguishable by the more angular shape of its aperture and by its excavated external side. All the other forms of the *aganitic* group, like *Naut. Franconicus*, Opp., or *Naut. Strambergensis*, Opp., have different sutures of the septa.

In Europe a very similar species occurs in the beds of *Perisph. anceps* of Württemberg, but it has as yet not been described under a separate name.

(?) *Group of* NAUTILUS MOJSISOVICSI, *Neumayer*.

(1). NAUTILUS JUMARENSIS, *Waagen*, n. sp., Plate IV, fig. 1, *a—b*, 2, *a—b*.

It is with great doubt that I unite the species from Jumara with *Naut. Mojsisovicsi*, Neum., in one group, as in the former the ornamentation is not so strong and is limited to the sides of the shell, but, at all events, Neumayer's species is more nearly allied to the Kutch form than any other as yet described.

Shell very thick, with flattened sides, flat external part and small umbilicus. The width of the umbilicus is, however, variable, and in one specimen its diameter is about one-ninth, in another about one-tenth of the diameter of the shell. The umbilicus is deep, with perpendicular walls; the umbilical edge, however, not sharp, but rather rounded. The sides are sloping towards the external part and a little excavated near it. The external part is flattened, with rather sharp edges on both sides. From the umbilical margin rise in adult specimens shallow obtuse folds, which extend, directed somewhat backward, to the external edge, and terminate here in a broad obtuse tubercle; no ornamentation of any kind passes the flat external part.

Young specimens are entirely smooth, the whorls more rounded in section. On the body chamber of very large specimens the ornamentation becomes less apparent, and the tubercles of the outer edge disappear entirely.

The septa are simply curved, a little cut out on the external part; the sipho is not preserved. On a cast of a young specimen, the normal line is well seen in the middle of the external side.

The dimensions are :

Diameter of the shell	112	mm.
„ of the umbilicus	12	„
Thickness of the shell	78	„
Height of the last whorl from the umbilicus	74	„
„ „ „ from the preceding whorl	61	„

Remarks.—*Naut. Jumarensis* is one of the rare forms, with decorated shell, which were only recently detected in Alpine jurassic strata. The species was found in three specimens in a yellowish-gray marly limestone directly below *Steph. macrocephalum* in the uppermost beds of the Putcham group, north-west of Jumara.

It is very remarkable how the species changes with age. Young specimens are barely distinguishable from *Naut. lineatus*, Sow., from the inferior oolite, whilst larger specimens are entirely different. The only species with which full grown shells can be compared is *Naut. Mojsisovicsi*, Neum., from the Macrocephalus beds of the Brielthal in the Sazkammergut. In the side-view, the ornamentation of both shells has a rather close resemblance, but in the Alpine species the umbilicus is larger, and the tubercles on the outer margin not developed, whilst in a front-view the smooth external part of *Naut. Jumarensis* immediately distinguishes both species. Besides that, in *Naut. Jumarensis* the ornamentation is chiefly restricted to the shell, and the cast shows very little of it.

PLATE I.

Fig. ... 1. Belemnites Stoliczkanus, *Waagen*, p. 10; specimen from the ferruginous sandstone of *Kuntkote;* 1*a*, front view, 1*b*, side view; 1*c*, *d*, *e*, sections through the guard at different heights, 1*f*, Phragmocone, front view.

Fig. ... 2. Belemnites fusticulus, *Waagen*, p. 9; specimen from the ferruginous sandstone of *Kuntkote;* 2*a*, front view, 2*b*, side view, 2*c*, *d*, *e*, sections through the guard at different heights.

Fig. ... 3. Belemnites Kuntkotensis, *Waagen*, p. 3; specimen from the ferruginous sandstone of *Kuntkote;* 3*a*, front view, 3*b*, side view, 3*c*, *d*, *e*, sections through the guard at different heights, 3*f*, Phragmocone, side view.

Fig. ... 4. Belemnites orientalis, *Waagen*, p. 5; specimen from the *Dhosa Oolite* of *Wanda;* 4*a*, front view, 4*b*, side view, 4*c*, *d*, sections through the guard at upper and near lower end, 4*e*, Phragmocone, section, side view.

Fig. ... 5. Belemnites Oldhamianus, *Waagen*, p. 15; specimen from the shales with *Per. anceps* of *Keera hill* near *Charee;* 5*a*, front view, 5*b*, back view, 5*c*, side view, 5*d*, longitudinal section of the guard from front to back with Phragmocone, 5*e*, transversal section.

Fig. ... 6. Belemnites Oldhamianus, *Waagen*, p. 15; specimen from the *Athleta*-bed, southeast of *Nurrka;* 6*a*, front view, 6*b*, back view, 6*c*, side view, 6*d*, longitudinal section of the guard from front to back with Phragmocone, 6*e*, transversal section.

JURASSIC CEPHALOPODA FROM KUTCH

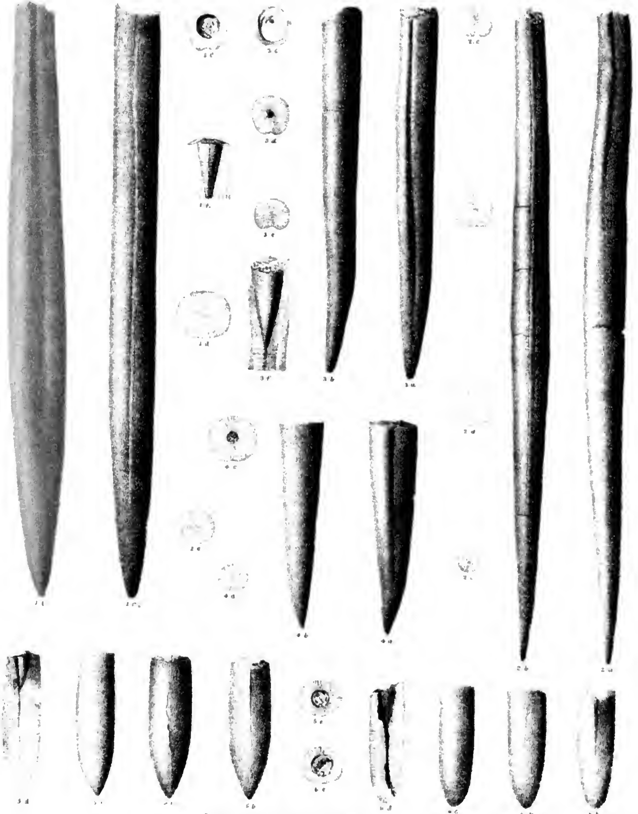

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PLATE II.

Fig. ... 1. **Belemnites sub-hastatus**, *Zieten*, p. 14; specimen from the *Macrocephalus-beds* between *Kumagoona* and *Oorira*; 1*a*, front view, 1*b*, side view, 1*c*—*d*, sections through the guard at different heights; 1*e*, longitudinal section of the Phragmocone of another specimen from the same locality, side view.

Fig. ... 2. **Belemnites claviger**, *Waagen*, p. 6; 2*a*—*e*, specimen from light coloured sandstone of the *Katrol-group* of the *Bothor river* near *Jurun*; 2*a*, front view, 2*b*, side view, 2*c*, *d*, *e*, sections through the guard at different heights; 2*f*—*h*, upper end of a specimen out of shales of the *Katrol group*, from *Lodai*, front view and sections.

Fig. ... 3. **Belemnites Gerardi**, *Oppel*, p. 13; specimen, imperfect at the apex, from the *Dhosa Oolite*, S. of *Samtra*; 3*a*, front view, 3*b*, side view, 3*c*—*d*, sections through the guard at different heights.

Fig. ... 4. **Belemnites Calloviensis**, *Oppel*, p. 14; specimen very likely from *Keera hill*; 4*a*, front view, 4*b*, side view, 4*c*—*d*, sections through the guard at different heights.

Fig. ... 5. **Belemnites Jumarensis**, *Waagen*, p. 12; specimen from the *Macrocephalus-beds* of *Jumara*; 5*a*, front view, 5*b*, side view, 5*c*—*d*, sections through the guard at different heights.

Fig. ... 6. **Belemnites Sauvanausus**, *Orb.*, p. 8; 6*a*—*d*. Specimen from the *Dhosa Oolite*, S. of *Samtra*; 6*a*, front view, 6*b*, side view, 6*c*—*d*, sections through the guard; 6*e*, longitudinal section through the alveolar region of another specimen from the *Dhosa Oolite*, S. W. of *Lodai*, side view.

Fig. ... 7. **Belemnites Katrolensis**, *Waagen*, p. 7; specimen from the coarse hard sandstone of the *Katrol range*; 7*a*, front view, 7*b*, side view, 7*c*—*e*, sections through the guard at different heights.

Fig. ... 8. **Belemnites Katrolensis**, *Waagen*, p. 7; specimen from the same beds and locality as the above; 8*a*, front view, 8*b*—*e*, sections through the guard.

Fig. ... 9. **Belemnites Katrolensis**, *Waagen*, p. 7; specimen out of shales of the *Katrol group* of *Lodai*, longitudinal section of the alveolar region, side view.

Geol Surv of India JURASSIC CEPHALOPODA FROM KUTCH. Pl. II

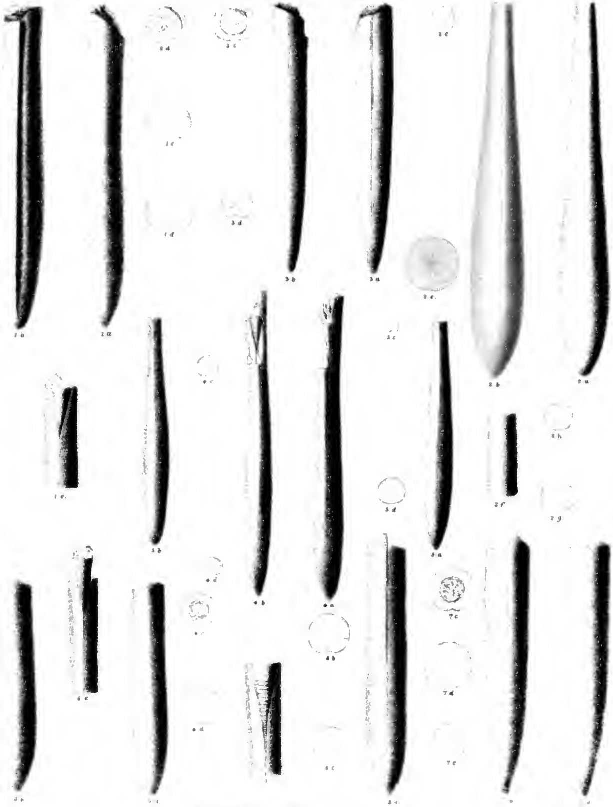

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PLATE III.

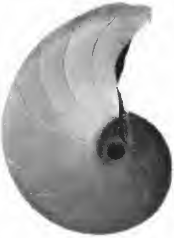
Fig. ... 1. NAUTILUS KUMAGUNENSIS, *Waagen*, p. 19; specimen from the upper region of the *Macrocephalus-beds*, N. of *Kumaguna*; 1*a*, side view, 1*b*, front view.

Fig. ... 2. NAUTILUS CALLOVIENSIS, *Oppel*, p. 18; specimen from the *Macrocephalus-beds*, N. W. of *Jumara*; 2*a*, side view, 2*b*, front view.

Fig. ... 3. NAUTILUS INTUMESCENS, *Waagen*, p. 20; specimen from the lowest region of the *Macrocephalus-beds*, N. W. of *Jumara*; 3*a*, side view, 3*b*, front view.

Fig. ... 4. NAUTILUS KUTCHENSIS, *Waagen*, p. 20; specimen from the beds with *Per. obtusicosta* of *Wanda*; 4*a*, side view, 4*b*, front view.

Geol Surv of India. JURASSIC CEPHALOPODA FROM KUTCH. Pl III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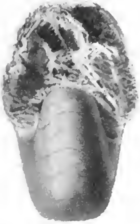
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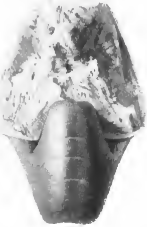
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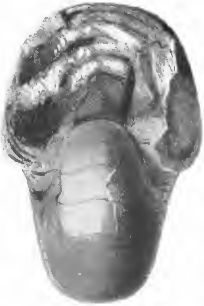
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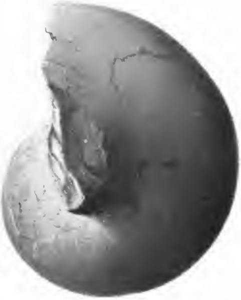
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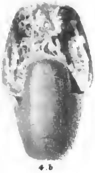
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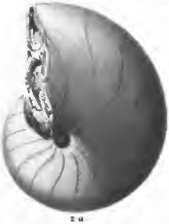
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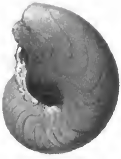
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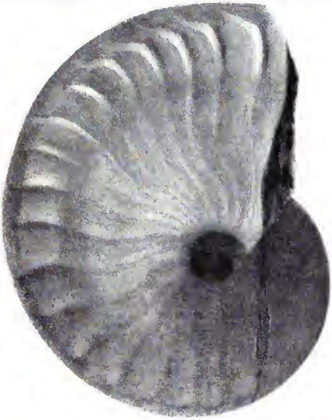
PLATE IV.

Fig. ... 1. **NAUTILUS JUMARENSIS**, *Waagen*, p. 21; specimen from the gray limestones of the *Putchum-group* of *Jumara ;* 1*a*, side view, 1*b*, front view.

Fig. ... 2. **NAUTILUS JUMARENSIS**, *Waagen*, p. 21; young specimen from the same beds and locality as the above; 2*a*, side view, 2*b*, front view.

Fig. ... 3. **NAUTILUS WANDAENSIS**, *Waagen*, p. 17; specimen from the *Dhosa Oolite* of *Wanda ;* 3*a*, side view, 3*b*, front view.



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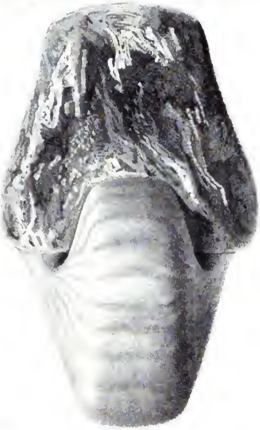

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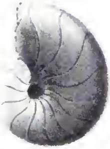

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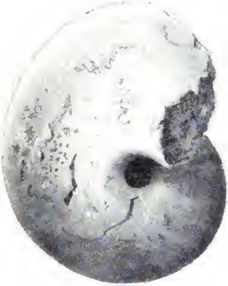

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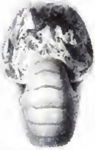

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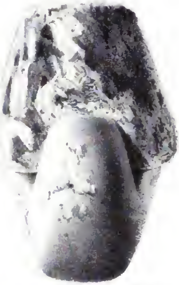

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J C Branner

MEMOIRS

OF THE

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Palæontologia Indica,

BEING

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JURASSIC FAUNA OF KUTCH.

Vol. I. 2.

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by WILLIAM WAAGEN, Ph. D.,
Geological Survey of India.

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CEPHALOPODA

OF THE

JURASSIC DEPOSITS OF KUTCH.

Order. TETRABRANCHIATA.

Family,—AMMONITIDÆ.

GENUS *PHYLLOCERAS*, SUESS.

This genus, though proposed in 1865 by Prof. Suess, was for a long time treated with great reserve by the scientific world, as the acceptance of it would have involved at the same time the acknowledgment of the principle on which it was founded, and that was precisely what it was thought desirable to avoid. If once the limits fixed by the common use of so many years were transgressed, one had to admit the consequences, and not only the genus *Phylloceras* must be accepted, but also the rest of the Ammonites must be subjected to further investigation and be dissolved into a number of genera, difficult to determine and difficult to circumscribe. But nevertheless the step had to be taken, not only because the number of Ammonite-species increased slowly to an excessive amount, but also, because discoveries were made regarding the shells of Ammonites which made it appear very improbable that all Ammonites could possibly belong to one and the same genus.

Prof. Zittel in 1868 was the first to accept the designation *Phylloceras*, as a generic name separate from Ammonites, and since that time, not only have Suess's genera come into common use, but also the greater portion of the other Ammonites have been divided into separate genera. How necessary and useful this was, soon appeared clearly from the other discoveries which were in the rear of this first step.

In his work on the Cephalopoda of Stramberg,* Zittel showed, that it was possible to arrange the species of *Phylloceras*, till then described, into certain rows or series, the species of which are for the most part nearly allied to each other, and in 1869 he published his discovery,* that the species of one and the same series differ principally in their lobes, which become more complicated, as the species are geologically younger. In the meantime I myself had made similar observations on other groups of Ammonites and had proposed to designate such relationships,† which no doubt had their origin in a genetic relation of the single species in time, by a certain formula, which I called the 'Genetic formula.'

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* Zittel: Die Cephalopoden der Stramberger Schichten, Palæontol. Mittheil., Vol. II, Abth. I.

Since that time several *Phylloceras* have been described, but no work was so important for the genus as the Memoir of Dr. Neumayr on the Phyllocerates of the Dogger and Malm only recently published in the Jahrbuch of the Austrian Geological Survey, and as it treats of species of the same geological periods as are developed in Kachh, it is of great value for determining and arranging the Kachh species.

Dr. Neumayr distinguishes the following groups :—

I.—Group of *Phyll. heterophyllum*, Sow.
II.—Group of *Phyll. tatricum*, Pusch.
III.—Group of *Phyll. capitanei*, Catullo.
IV.—Group of *Phyll. ultramontanum*, Zitt.

All these four groups are represented in different beds of the Kachh Jura, and though one or the other of them counts only one or two species here, whilst in Europe every zone has furnished a separate one, others are as rich (or even richer) in forms as they are in Europe.

The first of Neumayr's groups is represented only by a small specimen out of the beds with *Peltoceras athleta*, which I consider as belonging to *Phylloceras Kunthi*, Neum. The second group has furnished not less than five species, more than are known in the Jura of Europe. The oldest of them, *Phylloceras vicarium*, Waagen, n. sp., is found in the beds with *Steph. macrocephalum*, and there replaces the *Phylloc. flabellatum*, Neum., of Europe. Two other species, *Phyll. Feddeni*, W., and *Phyll. Jaraensis*, Waagen, n. sp., were found in the beds of *Asp. perarmatum*, the former allied to *Phyll. euphyllum*, Neum., but with somewhat simpler lobes, the other repeating the form of *Phyll. flabellatum* on a higher horizon, but with more complicated lobes. A fourth species, *Phyll. insulare*, Waagen, n. sp., comes from Gangta bét out of beds very likely of Upper Oxfordian age. It is allied to *Phyll. ptychoicum*, Quenst., but the tetraphyllism of the saddles is not well developed. The fifth species is *Phyll. ptychoicum*, Quenst., and occurs in the Ammonite beds of the Katrol group.

The group of *Phyll. capitanei*, Cat., is represented in Kachh by three species, of which one, *Phylloceras disputabile*, Zitt., is found in the *Macrocephalus* beds as a rather common fossil; another, *Phyll. Lodaiense*, Waagen, occurs also tolerably common in the beds of *Asp. perarmatum;* the third, which I identify, though doubtfully, with *Phyll. Benacense*, Cat., is found very rarely in the Ammonite beds of the Katrol group, the probable equivalent of the Kimmeridge group of Europe.

---

* Zittel: Bem. über Phyll. tatricum, Jahrb. d. K. K. Geolog. Reichsanst., Vol. xix, p. 59.

† Waagen: Formenreihe des *Amm. subradiatus*, Benecke's Geognost. Paläont. Beitr., Vol. II.

The last group of *Phyll. ultramontanum*, Zitt., has furnished in Kachh only one species, *Phyll. mediterraneum*, Neum., which seems, however, here restricted to Upper Callovian beds.

Altogether the genus *Phylloceras* shows here in the ten species, by which it is represented, the same laws and succession of forms as in Europe, so that we can, merely by judging from the complication of the lobes, indicate with tolerable certainty the geological age of a species. It is remarkable that the same species as in Europe are not always found on the same horizons in Kachh, and that it thus appears that the groups, though following the same laws of development as in the European Ammonites, yet were travelling a different road, notwithstanding the specific agreement at certain stages. Nothing could show more clearly than this, that it is an inner law, which governs the changes of form in the animal life. This may be influenced by outer circumstances, the result of which are 'local' or 'replacing' species, but the tendency is here and in Europe the same, so much so that after long deviation at last the same form is produced. Thus in the group of *Phyll. tatricum* all the older forms, *Phyll. vicarium, Feddeni, Jaraense* and *insulare* are different from European species, but they result at last in the newest form of the group in a species which agrees in every point with the European *Phyll. ptychoicum*. In the group of *Phyll. capitanei* the Indian series starts from a form identical with a European one, *Phyll. disputabile*, Zitt., and terminates also with a European one, *Phyll. Benacense*, Cat., but whilst in Europe the intermediate species are *Phyll. Manfredi* and *Puschi*, we have in India *Phyll. Lodaiense* as an intermediate form. Thus, it appears, the tendency is the same, but the ways are different.

(a.) Group of PHYLL. HETEROPHYLLUM, *Sow.*

1. PHYLLOCERAS *cf.* KUNTHI, *Neum.* Pl. V, Fig. 2*a, b, c.*

1868. *Phylloceras Kudernatschi*, (Hau.) Zittel: Jahrb. d. K. K. Geol. Reichsanst., Vol. xviii, p. 602.
1869. *Phylloceras Kudernatschi*, (Hau.) Zittel: *ibid*, Vol. xix, pl. 1, fig. 13.
1871. *Phylloceras Kunthi*, Neumayr: *ibid*, Vol. xxi, p. 312, fig. 6; pl. 13, fig. 1.

The species is only represented by a very small specimen, so that I cannot consider my determination beyond all doubt, but so much is certain, that the specimen belongs to the group of *Phyll. heterophyllum*, and is, if not identical, certainly very nearly allied to *Phyll. Kunthi*.

The specimen has only 18 mm. in diameter. The general form is flat, lenticular, with flattened sides, rounded siphonal part, and very small umbilicus. The shell, though partly well preserved, seems smooth, without striation. The lobes are tolerably fine, the external and first lateral saddle finish in four phylla; there are six auxiliary lobes up to the umbilical suture.

The dimensions are—

Diameter of the shell	18 mm.
„ of the umbilicus	1
Height of the aperture from the umbilical suture	11
„ of the „ from the preceding whorl	6
Thickness of the „	7

Remarks.—The only specimen is from Leir, out of white limestone with *Peltoc. athleta.*

The form of the lobes of the specimen seems not quite identical with that of *Phyll. Kunthi,* but rather intermediate between that of this species and *Phyll. isotypum,* Ben., but the materials at my disposal are too limited to found a new species on them.

(b.) Group of PHYLLOC. TATRICUM, *Pusch.*

1. PHYLLOCERAS VICARIUM, *Waagen.* Pl. V, Fig. 4*a, b, c.*

The general form of the shell is inflated, the whorls rounded with broad siphonal side and deep depressed umbilicus, repeating with slight variations the general form of all the species of the group.

The greatest thickness of the whorls is near the siphonal part of the shell. From these the sides slope gradually towards the umbilicus, which is flat, nearly without vertical walls. The siphonal side of the whorls is provided with distant short rounded ribs, of which there seem to be about eight or ten on one whorl. The ribs are indistinct on the cast, and do not correspond with curved furrows round the umbilicus; the cast is here smooth.

The lobes resemble very much those of *Phylloceras flabellatum,* Neum. The siphonal lobe is nearly as long as the first lateral. The external saddle finishes in two phylla, but with some tendency to tetraphyllism; the first lateral saddle finishes diphyllic. There are six auxiliary lobes up to the umbilical suture, which are all only slightly ramified. The second lateral and first auxiliary saddles terminate in two phylla.

The dimensions are—

Diameter of the shell	60 mm.
„ of the umbilicus	5
Height of the aperture from the umbilical suture	33·5
„ of the „ from the preceding whorl	22
Thickness of the „	26

Remarks.—The only specimen existing of this species comes from north-west of Jumara out of a yellow limestone together with *Steph. macrocephalum.*

The affinities are manifold. The most nearly allied species seems to be *Phyll. flabellatum*, Neum. This is found in Europe in the upper region of the Bathonian group, and is characterised by the shape of the whorls and furrows round the umbilicus. In the former point, *Phyll. vicarium* agrees with the European species, but the furrows are wanting, and the lobes more complicated.

From *Phylloc. tatricum* our species is distinguishable by the larger umbilicus and the external saddle, which is nearly tetraphyllic. *Phyll. euphyllum*, Neum., resembles also very closely *Phyll. vicarium*, but the lobes of the former are much more complicated. Thus the Indian form represents an easily distinguishable species, which is characteristic for the beds with *Steph. macrocephalum*.

2. PHYLLOCERAS FEDDENI, *Waagen*. Pl. VII, Fig. 1*a*, *b*, *c*.

The general form of this species is very like *Phyll. flabellatum*, Neum. The whorls are thick and rounded, the umbilicus small and deeply depressed, the siphonal margin shows sharp short ribs, which go over the siphonal part of the shell and then disappear. The number of those ribs is, on the example which lies before me, eleven to twelve.

If we examine the shell more carefully, we find that there are some peculiarities which never occur in *Phyll. flabellatum* or any allied form. The shell itself is quite smooth, and not the slightest trace exists of furrows, which descend from the folds on the siphonal margin to the umbilicus, nor can one see any mark of the umbilical rosette as it is called by Zittel, though the shell there is so well preserved that every stria of growth is visible. The only ornamentations of the shell are those folds on the siphonal margin which are short, tolerably high, and numerous. The lobes agree in their general form with those of *Phyll. flabellatum*, only the external saddle shows a slight difference, consisting in an asymmetrical dentation of the outer leaf, a beginning of the bipartition of this leaf. As we know by Zittel's discovery, that in the genus *Phylloceras* the changes which the forms undergo in the course of time are expressed chiefly by a change in the dentation of the last leaves of the external and first lateral saddle, this character seems to be of some value. Besides this, we count on our example ten to eleven lobes on each side of the shell instead of seven as drawn by Orbigny for *Phyll. Hommairei*.

The dimensions of our example are—

Diameter	of the shell	107 mm.
,,	of the umbilicus	11
Height	of the aperture from the umbilical suture	60
,,	of the ,, from the preceding whorl	43
Thickness	of the ,, ...	24

Remarks.—The species seems to be very rare in the Indian Jura, and it is represented in our Museum only by a single example. This comes from the Joora hills on the road from Jooria to Dhosa. The rock which contains the fossil is very much like the rock of Lodai, in which *Phyll. Lodaiense* occurs. It is a slightly sandy brown oolite with very small grains. The shells of the fossils are converted into very hard brown iron-ore, and it was therefore very difficult to get out the lobes of this species. The other Ammonites which are associated with *Phyll. Feddeni* are very numerous. They consist of forms which very likely indicate an Oxfordian age of the stratum. Among them we find *Peltoceras semirugosum* at Lodai associated with *Asp. perarmatum.* Therefore it is very probable that *Phyll. Feddeni* is an Oxfordian type, and it is of great interest to state that our species, both in its geological position and in its palæontological characters, establishes the junction between *Phyll. flabellatum* and *Phyll. ptychoicum.* It is more nearly allied to the former species than to the second, because its geological age is only a little younger than that of the first, but much older than that of the second one. *Phyll. euphyllum,* which also shows much resemblance to *Phyll. Feddeni,* has more complicated lobes; in *Phyll. vicarium* the first lateral saddle is diphyllic instead of triphyllic as in the species just described.

3. PHYLLOCERAS JARAENSE, *Waagen, n. sp.* Pl. V, Fig. 6*a, b, c.*

In general appearance this species strongly resembles *Phyll. semisulcatum* of the Neocomian.

The whorls are rounded, broadest near the siphonal part, the latter itself being smooth, without prominent ribs. The umbilicus is small, not very deep, surrounded by deep curved furrows, the so-called umbilical rosette, which are visible principally on the cast, but also on the shell a little fainter. The shell itself, as far as preserved, seems to be smooth.

The lobes are characteristic. The siphonal lobe is rather long, with two long, bifid terminating branches; the external saddle is unequal, tetraphyllic; the first lateral lobe only a little longer than the siphonal; the first lateral saddle also unequal, tetraphyllic, reaching high up. Second lateral lobes much shorter than the first. Second lateral and first auxiliary saddle diphyllic, the others monophyllic; six auxiliary lobes up to the umbilical suture.

The dimensions of the described specimen are—

Diameter	of the shell	48 mm.
"	of the umbilicus	4
Height	of the aperture from the umbilical suture	26
"	of the " from the preceding whorl	18
Thickness	of the "	22

Remarks.—The only specimen existing of this species was found north-west of Jara in the Oolites with *Asp. perarmatum.*

The affinities of the species are not equally great with the different species which are next to it in their geological position. The most nearly allied, it seems, is *Phyll. Jaraense* to *Phyll. flabellatum,* Neum., and in fact I believe that the former represents the latter in India in a higher layer. Both are, however, distinguishable by the wanting of folds on the siphonal side and the more complicated lobes in the Indian species. *Phyll. semisulcatum*, which in young specimens also very closely resembles *Phyll. Jaraense*, differs from this species by the smaller umbilicus, the more strongly curved furrows of the umbilical rosette, and the equal tetraphyllic termination of the external and first lateral saddle. Nearly in the same points it differs also from *Phyll. ptychoicum*, Quenst. *Phyll. Feddeni*, of the same bed as *Phyll. Jaraense*, has quite different lobes.

4. PHYLLOCERAS INSULARE, *Waagen, n. sp.* Pl. IX, Fig. 3*a, b, c*.

Small specimens of this species have not very much the look of a form belonging to the group of *Phyll. tatricum*, as the whorls are smooth, rounded, without ribs on the siphonal side, or a rosette round the umbilicus. Only larger specimens have folds like *Phyll. ptychoicum*.

The greatest thickness of the whorls is near the siphonal part of the shell; from there the flatly rounded sides slope gradually towards the umbilicus, which is tolerably wide and rather deep. The shell seems entirely smooth, and neither the casts nor specimens with preserved shell show any ornamentation up to a diameter of 50 mm.

The lobes are very much like those in *Phyll. ptychoicum*. The siphonal lobe is as long as the first lateral, the external and first lateral saddles are very unequally tetraphyllic. Second lateral lobe shorter than the siphonal, second lateral saddle diphyllic; auxiliary lobes five up to the umbilical suture.

The dimensions of the described specimen are—

Diameter of the shell	46 mm.
„ of the umbilicus	7
Height of the aperture from the umbilical suture	25
„ of the „ from the preceding whorl	?15
Thickness of the „	20

Remarks.—The specimen from which I have described the species was found at Gangta Bót, an island in the Rann, in a sandstone, together with other Ammonites of very probably upper Oxfordian age.

All the characteristics of the shell show it to be most closely allied to *Phyll. ptychoicum*. Like this species in its typical form, *Phyll. insulare* gets the folds on the siphonal part only at an advanced stage of growth, being in early youth quite smooth. The lobes are distinguished by the small development of the inner two phylla in the external and first lateral saddle of the Indian species. All the other species, which could be compared with *Phyll. insulare*, are easily distinguishable by the ornamentations of the shells or casts, or by the differences of the lobes, which, although very minute, are always constant enough to characterise with certainty the species.

5. PHYLLOCERAS PTYCHOICUM, *Quenst.* Pl. VII, Fig. 2*a*, *b*, *c*.

1845. *Ammonites ptychoicus*, Qneustedt: in Leonh. and Bronn, Jahrb. für Mineral, p. 683, 1847 Cephalop., p. 219, pl. 17, fig. 12.
1866. *Ammonites ptychoicus*, (Quenst.) Benecke: Geognost. Pal. Beitr. I, p. 188.
1866. *Ammonites semisulcatus* (Orb.) Hébert: Bull. Soc. Géol. de Fr. 2ème, Sér. XXIII, p. 525.
1868. *Phylloceras ptychoicum*, (Quenst.) Zittel: Cephalop. d. Stramberg, Schichten, p. 59, pl. 4, figs. 3—9.
1869. *Phylloceras ptychoicum*, (Quenst.) Zittel: Jahrb. d. K. K. Geol. Reichsanst., XIX, p. 65.
1870. *Phylloceras ptychoicum*, (Quenst.) Zittel: Fauna d. ält. cephalopoden führend. Tithonbild., p. 35, pl. 1, figs. 11, 12, 13.
1871. *Phylloceras ptychoicum*, (Quenst.) Neumayr: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xxi, p. 326, pl. 16, fig. 10.

Phylloceras ptychoicum is one of the most interesting species of all those found in the Kutch Jura, not only for its palæontological characters, but still more for its geological value.

It was formerly a species very difficult to determine and certainly not easy to recognise. But since the excellent descriptions of Zittel, and his discovery of the law of the alteration of the lobes in *Phylloceras* have been published, nothing is easier than to determine this species with all desirable certainty.

The general form is thick, rounded, with inflated whorls and small umbilicus. On the broad, rounded siphonal side there are short, rather sharp ribs, which pass over it. Those ribs belong chiefly to the shell itself; on the casts they are almost invisible. The example which I have to describe bears them on the chambered part of the shell. Besides those ribs no ornamentation is visible.

The lobes are most characteristic, and on them the external and first lateral saddle are the most important parts. The external saddle is beautifully symmetrical, finishing in four phylla, of which the two corresponding ones are equal; the first lateral saddle is also divided into four terminating phylla, which are, however, not quite symmetrical. The whole lobe shows eight lateral lobes on each side of the shell.

The dimensions of the described specimen are—

Diameter of the shell	90 mm.
" of the umbilicus	7
Height of the aperture from the umbilical suture	53
" of the " from the preceding whorl	37
Thickness of the "	39

Remarks.—The specimen described is from east of Lair, north base of Katrol range, out of a red sandy rock with very hard concretions of sandy limonite. It seems to occur there together with *Perisphinctes Pottingeri*, Sow. sp., *Oppelia trachynota* and *cutchensis*. In Central Italy *Opp. trachynota* is also found in its society, and it is remarkable that there the same variety occurs as is represented by the Cutch specimen with the ribs exclusively on the siphonal side of the chambered part of the shell. The position of the Italian fossils is very well determined by Zittel as of Tithonian age. Thus *Phylloceras ptychoicum*, wherever it has yet been found in Germany, France, Spain or Italy, characterises with great certainty the same horizon, and is one of the chief representatives of the Tithonian Fauna.

As to its palæontological affinites to *Phyll. Feddeni*, before described, *Phyll. ptychoicum* has a much smaller umbilicus, flatter sides of the whorls, and tetraphyllic external and first lateral saddles, whilst *Phyll. Feddeni* has the external saddle diphyllic, with a little indication of triphyllism, and the first lateral saddle purely diphyllic. The differences from *Phyll. flabellatum* and the other forms of this group consist chiefly in the lobes, and to a much less extent in the ornamentation of the casts or shells, but the distinction of the species is never very difficult.

(c.) Group of PHYLLOCERAS CAPITANEI, *Catullo.*

1. PHYLLOCERAS DISPUTABILE, *Zittel.* Pl. VI, Figs. 1*a*, *b*, 2*a*, *b*, *c*, 3.

1852. *Ammonites tatricus* (Pusch.) Kudernatsch: Die Ammoniten von Swinitza, Abhandlungen d. K. K. Geologischen Reichsanstalt in Wien, Bd. I, p. 4; pl. I, figs. 4—6. (*non* Pusch).

1869. *Phylloceras disputabile,* Zittel: Bemerkungen über einige Phylloceras Arten. Jahrb. d. K. K. Geolog. Reichsanst. in Wien, Vol. xix, p. 63.

1871. *Phylloceras disputabile,* (Zitt.) Neumayr: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xxi, p. 332, pl. 14, fig. 7.

This species has been already very accurately described by Kudernatsch, and especially he has with great care noticed the changes which it undergoes from age, so that only little remains to be said regarding it.

The first stage of development I cannot observe with sufficient certainty, because there is only one example by which I could get out the inner whorls, but this specimen represents a variety, of which I am not quite sure, if it belongs to this species or represents a separate one; at all events it agrees so far with *Phyll. disputabile* that only the more inflated form of the whorls of this example would separate it from the mentioned species.

Exactly, as stated by Kudernatsch, we have here also the youngest states of growth smooth, and without those fine striæ which larger specimens show. The furrows on the cast are flat, and more rounded slight impressions than furrows. Beyond a diameter of 15 mm. the striæ become distinct, but only when of a diameter of 25 do the furrows become deeper and strongly defined. In the same degree as the furrows become distinct, the short rounded ribs on the outside of the shell become first distinguishable, then more and more high; they remain until a great age has been obtained by the shell, but it seems that these then begin again to become a little less distinct.

The number of the furrows on the cast, or rounded ribs on the shell, is in different individuals very variable; here in the Indian Jura, even more so than in the Jura of the Banat. The lowest number I can observe is five, the highest nine. To show this variability I have figured, pl. vi, figs. 1, 2, and 3, three different individuals, one with five, one with six, and one with seven furrows or rounded ribs. Large examples of this species, if well preserved, look very much like the figure of *Phyll. Kochi*, Opp., as given by Zittel; only the granulations of the outer margin of the shell are wanting, but even in *Phyll. Kochi*, as Zittel states in one of his more recent publications, these are only accidental and depend upon the preservation.

The measurements of some examples are as follows :—

	I.	II.	III.
Diameter of the shell	67 mm.	130 mm.	195 mm.
„ of the umbilicus	5	6½	8
Height of the aperture from the umbilical suture ...	37	73	111
„ of the „ from the preceding whorl ...	21	39	58
Thickness of the „	26	42	57

Remarks.—The specimens I have for examination are eight in number, mostly from Keera hill near Charee, where they occur together with *Steph. macrocephalum.* One specimen is out of the same bed from north-west of Soorka. The proper layer in Europe for this species is the zone of *Amm. ferrugineus*, in the middle jurassic formation, and it is very remarkable to find here in India the same form, without showing the least differences, in the society of *Steph. macrocephalum*, etc., near Charee, (Kelloway) after the lapse of all the long period during which the Bath-Formation was deposited in Europe. Only after having settled here for some time, the influences of the different conditions, together with the separation from the other individuals of its own tribe, have effected a slight change in its general form and lobes, and have given rise to the following species. In Europe, in the meantime, the changes took place in another direction, so that there *Phyll. Puschi* is found in the place of *Phyll. Lodaiense.*

2. PHYLLOCERAS LODAIENSE, *Waagen*. Pl. V, Fig. 5*a, b;* Pl. VI, Fig. 4*a, b, c*.

The general aspect of this species is throughout like all of this group, and only the differences of the other species serve as characteristics of this one. It is therefore very difficult to give a regular diagnosis, because those fine differences require a longer description than it is possible to give in a brief diagnosis.

Like the preceding species, *Phyll. Lodaiense* has a finely striated shell, on which, however, the ribs, which characterise the other species of the group, are barely visible. The number of furrows beneath the shell is only five on all the examples which are in the possession of our Museum. The furrows are characteristic; they are not, as in *Phyll. disputabile*, equal in depth and breadth in their whole extension, but are very strong and deep near the umbilicus, and almost disappear near the siphonal part of the whorls. This gives our species a somewhat different aspect from the preceding species, and makes it easy to recognise it at first sight. The lobes of *Phyll. Lodaiense* agree in their general type throughout with the lobes of ***Phyll. disputabile;*** only by careful examination one will find that there are differences of some importance. If we compare the first lateral saddle of the two species, we find that in ***Phyll. disputabile*** the three phylla terminating the saddle are unequal, the middle one being the longest, whilst in ***Phyll. Lodaiense*** all three are equal. All this seemed to me sufficient to justify our regarding this form as a separate member in the same developmental series.

The measurements of our larger example are—

Diameter	of the shell	88 mm.
„	of the umbilicus	6
Height	of the aperture from the umbilical suture	50
„	of the „ from the preceding whorl	27
Thickness	of the „	29

Remarks.—There is some doubt if our species may not be identical with ***Phyll. Manfredi***, Opp. I have here no example to compare the two species in nature; but as far as I can judge from the figures, it seems to me that ***Phyll. Manfredi*** differs from our species by thicker and more rounded whorls, by furrows, which are deepest on the siphonal margin, and by well developed folds on the siphonal side of the shell. ***Phyll. Puschi***, Opp., is also nearly allied, but the great number of furrows and the much more complicated lobes allow of its being easily distinguished.

The examples I have to describe are four, all being found in the fine brown oolite with ***Asp. perarmatum*** at the following localities: Lodai (one specimen), north of Dhosa (two specimens), west of Jumara (one specimen).

3. PHYLLOCERAS BENACENSE, *Catullo.* Pl. V, Fig. 3*a*, *b*, *c*.

1847. ***Ammonites Benacensis***, Catullo: Primo Appendice al Catalogo degli Ammoniti delle Alpi Venete, p. 9, pl. xii, fig. 1.
1871. ***Phylloceras Benacense***, (Cat.), Neumayr: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xxi, p. 336, pl. xv, fig. 3.

It would have been impossible to recognise this species without the excellent drawings and descriptions in the Vienna Jahrbuch.

The specimens I have got for description are very defective, the one being more or less compressed, the other a fragment of a small specimen; but the smaller one exhibits so clearly lobes identical with those of ***Phyll. Benacense*** that there can be no doubt about the determination. The species is flat, compressed, with rounded siphonal side and a tolerably wide umbilicus. The whorls are provided, as it seems, with not more than five contractions on each circuit. The furrows produced by them on the cast are very slightly falciform and very shallow. The shell itself is not sufficiently preserved to notice whether there are on the outer side of it ribs on the siphonal part corresponding to the furrows on the cast.

The lobes are very characteristic. In their general form they agree very much with the lobes of ***Phyll. disputabile***, Zitt., but the external saddle is decidedly tetraphyllic, and the first lateral saddle pentaphyllic; of the five leaves, however, with which this saddle terminates, two are much smaller than the other three. Of auxiliary lobes there are five standing outside the umbilical suture; the saddles between them are diphyllic, except the last two.

The dimensions of a somewhat compressed specimen from the Katrol range, as far as I can observe them, are—

Diameter	of the shell	77 mm.
„	of the umbilicus	7
Height	of the aperture from the umbilical suture	44
„	of the „ from the preceding whorl	?27
Thickness	of the „	?

Remarks.—The two specimens of this species I have for description are from different localities, but both out of the Katrol group. One was found on the Katrol range itself in an iron-stained nodular sandstone, the other comes from east of Rodur out of sandy shales.

The most nearly allied species to *Phyll. Benacense* is *Phyll. Puschi*, Opp., but the first lateral saddle has in the latter species only four terminating phylla instead of five, and in all the Indian species like *Phyll. Lodaiense* or *disputabile*, the number of those phylla is reduced to three, so that *Phyll. Benacense* appears as a well characterised and easily distinguishable species.

(d.) Group of PHYLLOCERAS ULTRAMONTANUM, *Zitt.*

1. PHYLLOCERAS MEDITERRANEUM, *Neum.* Pl. V, Fig. 1*a*, *b*; Pl. VII, Fig. 3*a*, *b*, *c*.

1852. *Ammonites Zignodianus* (Orb.) Kudernatsch: Abhandl. d. K. K. Geolog. Reichsanst., I, pt. 2, p. 8.
1854. *Ammonites Zignodianus* (Orb.) Hauer: Sitzungsber. d. K. K. Acad. d. Wissensch. in Wien, Vol. xii, pt. 5, p. 893.
1859. *Ammonites Zignodianus* (Orb.) Villanova: Mem. de la real Acad. de Cienc. de Madrid, Vol. iv, pl. 1, fig. 7.
1868. *Phylloceras Zignodianum* (Orb.) Zittel: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xviii, p. 603.
1870. *Phylloceras Zignodianum* (Orb.) Zittel: Fauna d. ält. cephalopoden führenden Tithonbild., p. 40, pl. 1, fig. 15, pl. 2, fig. 1.
1871. *Phylloceras Mediterraneum*, Neumayr: Jarhb. d. K. K. Geolog. Reichsanst., Vol. xxi, p. 340, pl. 17, figs. 2—5.

In Europe this species has a very large vertical distribution, and ranges from the Bathonian up to the uppermost jurassic group; not so in Kachh, where it seems to be limited to upper Callovian beds.

The specimens I have for examination closely resemble in every respect the European form, only the umbilicus seems to be commonly a little larger.

The general form of the shell is flattened, with flatly rounded sides of the whorls, a rather broad siphonal part, and a tolerably wide open umbilicus. The shell itself is provided with seven or eight contractions on one circuit which are deeply cut in at the siphonal part, and then continue as slight, strongly falciform curved furrows over the sides of the whorl; at the umbilical margins they are again a little more distinct. On the cast these contractions are marked by deep furrows, which are deeper near the umbilical margin and on the siphonal part, and are a little flattened in the middle of the sides of the whorl, where they make a strong bend towards the front. Between the contractions there are on the siphonal part of the shell fine filiform ribs which are worn off on the small specimens figured on pl. VII, fig. 3, but which are well visible on the larger example, pl. V, fig. 1. On the sides of the whorls those ribs change into the common striæ of growth. Different specimens are very variable in thickness, but the other characteristics remain the same.

The lobes are only visible on one small specimen from west of Soorka, but typically agree entirely with those figured by Zittel or Neumayr; the external saddle being diphyllic, and the first lateral one triphyllic. However, the lobes of our Indian specimen seem a little more finely divided on the whole than those in Neumayr's figure.

The body-chamber comprises one-half of the last whorl. The aperture is preserved in the specimens I have for examination, only in the part near the umbilical suture.

The dimensions of three different specimens are—

		I.	II.	III.
Diameter	of the shell	?70 mm.	110 mm.	165 mm.
„	of the umbilicus	10	19	27
Height	of the aperture from the umbilical suture ...	34	53	75
„	of the „ from the preceding whorl ...	22	34	?
Thickness	of the „	24	36	54

Remarks.—There are five specimens of *Phyll. mediterraneum*, known from Kachh, which all were found in beds a little above *Steph. macrocephalum* and below *Asp. perarmatum*. The localities are, west and north of Soorka, three specimens, found in gray shales with ferruginous concretions; north-west of Jara, in a yellowish white limestone together with *Pelt. athleta* (one specimen), and at Keera hill near Charee, in a hard yellow limestone (one specimen).

The observation of M. Neumayr, that *Phyll. zignodianum*, Orb., is a species of the Inferior Oolite and different from the species in the Mediterranean province, is of great value, as the differences which always existed between the specimens and Orbigny's figure are thus at once explained. *Phyll. mediterraneum* is now a well founded and easily recognisable species, which can scarcely be mistaken for any other.

GENUS *LYTOCERAS*, SUESS.

There is a beautiful specimen in our Museum coming from the jurassic layers of Kachh which belongs to this genus, and which is certainly one of the largest representatives of it existing. After careful examination, I cannot identify it with any described species, and I therefore shall describe it under the name of *Lyt. rex*. Another species, much less well preserved, but existing, however, in very characteristic fragments, is *Lytoceras Adeloides*, Kudernatsch.

As to the developmental series in this genus, I can from my material here add very little to the facts as yet known. I can only ascertain that the views of Zittel on this subject are quite right, and show that my examples in some points serve to prove the facts stated by him. The developmental series, to which the two species I am going to describe belong, may be called the

Group of LYTOCERAS EUDESIANUM, *Orb.*

1. LYTOCERAS REX, *Waagen, n. sp.* Pl. VIII, Fig. 1*a*, *b*.

The only example lying before me has 600 mm. in diameter. The general aspect at first recalls *Lyt. Eudesianum*, or an allied form. The whorls are rounded, a little higher than broad, almost not touching each other; the increase of the whorls is, as in *Lyt. Adeloides*, 2·5. I count about seven whorls on this specimen. The inner ones, up to a diameter of 300 mm., are covered with fine, closely arranged undulated ribs, all of equal strength, as is shown on the figures of *Lyt. montanum* and *sutile*, Oppel. Exceeding a diameter of 300 mm. the ribs of the specimen become very slight and indistinct, only a few increase very much in strength and bear rather high, folded lamellæ; they are equidistant from each other, and I count about eighteen on the last whorl which belong for the greater part to the body-chamber. The lamellæ themselves are cut out or folded backwards as in all the *Lytoceras*, and of those folds there are fourteen to sixteen on one lamella round the whorl.

The existing example has nearly the whole body-chamber preserved, and the length of it is about one-half of a whorl. The rock in which the specimen is included is not adapted for getting out the drawings of the sutures, and I am therefore very sorry to be unable to describe exactly the lobes. On parts of the shell a little weather-worn, one can remark that there were, as in all *Lytoceras*, two very extended lateral lobes.

The dimensions of the only example are—

Diameter of the shell	600 mm.
" of the umbilicus	235
Height of the aperture	220
" of the preceding whorl	110
Thickness of the aperture	200

Remarks.—If we regard the species, setting aside the last whorl, we would find it difficult to distinguish the specimen from *Lyt. sutile*, Opp., to which our species certainly shows a great affinity. The undulations of the ribs of the inner whorls are not distinct enough to count them with certainty, but as soon as some few principal ribs are distinguishable, one remarks, that there are only seven on one side of the whorl instead of many as in *Lyt. sutile*. That brings this form nearer to *Lyt. Eudesianum*, where only six such undulations can be counted. In this latter species, however, from the very youngest stage of growth, already principal and secondary ribs are distinguishable, whilst, on the contrary, *Lyt. rex* shows them only on the last whorl. We have therefore here a species which is equally allied to *Lyt. sutile* as to *Lyt. Eudesianum*, but identical with neither of them.

There is therefore, I suppose, no doubt that *Lyt. rex* belongs to the developmental series of *Lytoceras Eudesianum*, but, if this be so, the laws of development, which Zittel pointed out for this series, are true only to a certain extent, but must be changed a little, if we are to unite all the allied forms under this group. There is no doubt that if we start, like Zittel, from *Lyt. cornucopiae*, Y. and B., we find that the changes of the mutations are in general expressed by diminishing the number of undulations of the ribs. But having arrived at a minimum in *Lyt. Adeloides*, Kudern., the number of undulations increases again gradually, but the principal ribs, which are very characteristic for the geologically older species, now disappear, and are only limited to the last whorl and body-chamber, or are entirely wanting.

The rock which contains the fossil is a grayish-yellow, partly soft, partly very hard sandstone, with veins of iron-ore in every direction: *Lyt. rex* is the only fossil out of this rock I know. According to Mr. Wynne's indication, the layer which contained the species is rather high above the golden oolite a little south of Keera hill near Charee; from a palæontological point of view, one should judge that *Lyt. rex* had a position lower than Tithonian and higher than Oxfordian layers.

2. LYTOCERAS ADELOIDES, *Kudernatsch*. Pl. VIII, Fig. 2.

1852. *Ammonites Adeloides*, Kudernatsch: Abhandl. d. K. K. Geolog. Reichsanst., Vol. I, Abth. 1, p. 9, pl. 2, figs. 14—16.

1868. *Lytoceras Adeloides*, (Kudern.) Zittel: Jahrb. d. K. K. Geolog. Reichsanst., Vol. xviii, p. 603.

In general form, this species is very nearly allied to that just described, or also to *Lyt. Eudesianum*. The whorls are very loose, almost not touching each other, and therefore on the inner or dorsal side of the whorls almost not impressed. The section of the whorls is a little broader than high, but there is, it seems, a little variation in this, and this character is not quite constant. The whorls rapidly increase. The sculpture of the shell is, in all the fragments at my disposal, not very well preserved, but sufficiently to show the characteristics of the species. I count on half a whorl about twelve prominent ribs, between which finer ribs are placed. The prominent ribs have on their top, when well preserved, shelly lamellæ, with three to four folds each. Those ribs begin already in a small diameter of the shell, and examples of about 150 mm. diameter show them very strongly. All this shows the identity of our specimens with *Lyt. Adeloides*, Kudern., as described by Kudernatsch, and even better fixed by Zittel. But the lobes also, which I have figured on plate VIII, fig. 2, are quite identical, of course setting aside the changes of age. The most characteristic fact seems to me to be, that the branches of the first lateral lobe quite envelope the siphonal tube. Kudernatsch states this in his description, and I also found it in the examples from Kachh. I have no unbroken specimen, and therefore I cannot give accurate measurements.

Remarks.—It was for a long time doubtful if this species should be separated from *Lyt. Eudesianum*, and Hauer, in his notes regarding this species, comes to the conclusion that there is no difference between them. Only Zittel, after having carefully examined large materials, has, influenced by the idea of developmental series, pointed out that there are some slight but very constant differences, sufficient to justify the acknowledgment of a separate mutation. This example shows more clearly than any other how the descendental theory, used in the right direction, instead of causing a superficial examination of natural objects, conducts, on the contrary, to the most conscientious comparison of the separate forms. The principal misconception entertained on this subject arises from the fact, that people will not allow the idea that there are no radical differences between single species. The distinction of species is in reality only a counting up of the accumulations of changes which all forms undergo in the course of time. Now, it is quite natural, that forms, separated by a long interval of time, or such as rise from a different root, show strong differences, whilst others very nearly connected in time and root appear similar to a high degree. But is it right to ignore, therefore, the latter and to notice only the first? Certainly not; if we have to write a history of life upon the earth, and this alone can be the problem of Palæontology, we must mark not only the stages, but also the footsteps of the development of forms, because only by following up footstep by footstep we will at last discover the secret of the creation.

As such a footstep now I consider *Lyt. Adeloides;* the stage and root at the same time is *Lyt. Eudesianum;* therefrom rises the whole developmental series. In one of my former papers I have proposed a certain way of writing to signify those relations between some Ammonites, and in this case I should write *Lyt. Adeloides*, Kud. (R. *Eudesianum*, Orb). The latter of the two names, I called the root, radix (= R), the former I called mutation, and the whole, the genetic or developmental formula. *Lyt.* R. *Eudesianum* alone, however, would signify the whole of the forms, which spring from this species, the whole developmental series or group as I called it formerly. In the special case now referred to, *Lytoceras Adeloides* is a mutation of the collective species *Lyt. Eudesianum.*

All the specimens I have here for examination came from Keera hill near Charee; they are fragments of four different individuals. The rock in which they are preserved is the fine, golden oolite, which contains *Steph. macrocephalum.* We find here, therefore, *Lyt. Adeloides* in the same position as in the Brielthal in the Austrian Alps.

GENUS *AMALTHEUS*, MONTF.

Of the many generic designations Montfort once proposed for the different forms of fossil cephalopoda but very few have remained in use up to this; and especially the divisions he made among the Ammonites were thought perfectly unacceptable, not without reason, because Montfort's genera were formed in quite an arbitrary way, without following any principle, and thus they were useless to science in by far the greater number of cases. Nevertheless, the names were given, and, in all cases, where their meaning could be found out with certainty, had to be used, if a generic name was thought desirable for the forms in question. Thus, in dissolving the old genus Ammonites into several smaller genera, Montfort's names had again to be taken into consideration, and Hyatt[*] was perfectly right in using the generic name of *Amaltheus* for the group of *Amalthei* of former authors, because the figure given by Montfort[†] cannot possibly be mistaken as representing anything but the form generally known as *Amm. margaritatus,* Montf.

It is differently with others of Montfort's names, such as *Pelagus, Planulites, Simplegades, Ellipsolithes,* etc.; none of the figures given to illustrate these genera is recognisable as a certain definite species, and even the group they possibly could belong to is very doubtful, and thus all these names cannot be used in science any more, but must become obsolete, and it was necessary to create new names for other divisions of Ammonites.

The genus *Amaltheus* is one of the least known among the jurassic genera of Ammonites, and principally the species occurring in the 'Dogger' formation are generally so rare that it was for a long time doubtful if any true *Amaltheus* could be assigned to the middle jurassic beds.

So much more interesting is it therefore to find two species of this genus in the Kachh Jurassics, and one of them agreeing in every respect with a beautiful European species, *Amaltheus pustulatus,* Rein. The latter has been found by Dr. Stoliczka in nearly the same geological position as it occurs also in Europe, that is, together with *Pelt. athleta.*

The other is a new species, which I shall call *Amaltheus Schaumburgi* in honor of the artist under whose direction the plates have been executed. It occurs, like the other species, in the beds with *Pelt. athleta.*

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[*] Hyatt, 1868. The fossil cephalopoda of the Museum of Comp. Zoology: Bull. of the Mus. of Comp. Zool. at Cambridge, Mass, p. 90.

[†] Montfort, 1808. Conchyliologie systematique, 1, p. 90.

1. AMALTHEUS PUSTULATUS, *Reinecke, sp.* Pl. IX, Fig. 2*a*, *b*, *c*.

1818. *Nautilus pustulatus*, Reinecke: Maris protogaei Nautilos et Argonautas, figs. 63, 64.
1846. *Ammonites pustulatus*, (Rein.) Orbigny: Paléont. Franç. Terr. Jurass., I, pl. 154.
1846. „ *pustulatus Franconicus*, Quenstedt: Cephalopoden, page 134, pl. IX, fig. 22.
1857. „ *pustulatus*, (Rein.) Oppel: Jura formation, page 560.
1858. „ *pustulatus*, (Rein.) Quenstedt: der Jura, p. 525, (pars), pl. 69, figs. 32, 33.

Though only represented by a single specimen, this species being too characteristic to be mistaken, can be identified with tolerable certainty with the European one.

The specimen I have for description is a rather large one, but yet filled with air-chambers up to its end. The general form of the shell is inflated, the whorls being about as thick as high; the umbilicus is not very large, but deep, and surrounded by nearly perpendicular walls, which form a rounded edge with the sides of the whorls. The latter are flattened, covered with unequal strong ribs, which are for the greater part provided in the middle of the sides with strong spines, which, however, are generally broken off and then leave behind thick rounded tubercles. The ribs commence at the umbilical margin very low, increasing rapidly in height as they run in nearly a radial direction over the sides of the whorls; partly they divide into two, where they carry the tubercles; partly they remain unchanged, provided again with strong tubercles at the rounded edge, where the lateral and siphonal parts of the shell are touching. Thus there are two rows of tubercles running along the whorls, one in the middle of the sides, and one at the edge of the siphonal part of the shell. Some of the ribs are divided again at this second row of tubercles, most of them are not, but all are turned a little in front at the siphonal part. In the middle of the siphonal part of the whorls a keel exists, which is protracted into elongated tubercles where the ribs are touching it. These tubercles appear like a crest, when the shell is preserved, but generally the shell is partly broken off, and then the tubercles are rounded, low, and little distinct.

It was Quenstedt who first called attention to the peculiarities of the keel of this species. He proposes to form a new group of this and some allied species, for which he gives the name of "*Dorsocavati.*" In preparing the specimen here described for description, I could well prove also for the Indian shell the same peculiarities, consisting in the keel being hollow and forming a separate tube, divided from the inner space of the whorl by a thin shelly layer, and nowhere communicating with the air-chambers, entire in itself, and admitting the entrance of the seawater all along the whole spiral of the shell.

The entire shell is covered with fine concentric striæ, as they are observable in most of the *Amalthei*.

The lobes are nowhere visible, as the whole specimen is covered with thick black shell.

The dimensions are—

Diameter	of the shell	90 mm.
„	of the umbilicus	19
Height	of the aperture from the umbilical suture	44
„	of the „ from the preceding whorl	35
Thickness	of the „	40

Remarks.—The only specimen of this species from Kachh preserved in our Museum has been found by Dr. Stoliczka at a considerable distance north-east of Gudjinsir in a black shale, together with some fragments of *Pelt. athleta,* Phill.

Our Indian specimen agrees in general very well with the figures given by Quenstedt, less so with d' Orbigny's drawing. The ribs are more simple in our specimen than they are drawn there, and generally do not divide at the tubercles; then nearly every one of the ribs corresponds with a tubercle on the siphonal keel, contrary to d'Orbigny's figure, where three or four ribs unite in one tubercle. These differences, however, did not seem to me sufficient to distinguish a new species, as among the small pyritic specimens, found at Gammelshausen in Württemberg, a great variability in this respect is exhibited. Another difference between the Indian and the European specimens lies in the tubercles, of which in the Indian shell the outer row is the strongest, whilst in the other ones the inner tubercles are the more prominent. In consequence of this the transverse section of the whorl has a somewhat different appearance.

The geological position in which *Amalth. pustulatus* is found generally in Europe is not much different from that in which it occurs in India.

In Württemberg it is one of the most beautiful fossils of the "Brauner Jura, Z.," of Quenstedt, or of the "Ornatenthon" of Leopold von Buch. Nearly the same position of the species is indicated for the Indian specimen by its occurrence together with fragments of *Pelt. athleta,* which in Europe is also a species of the "Ornatenthon." The only difference is, that this latter fossil in Europe generally marks the upper region of these beds; *Amalth. pustulatus,* on the contrary, the lower region, and thus both species are generally not found together.

2. AMALTHEUS SCHAUMBURGI, *Waagen, n. sp.* Pl. IX, Fig. 1*a*, *b*, *c*.

This species in many respects resembles *Amalth. polygonius,* Zieten, sp., but nevertheless I think it necessary to create a new name for it on account of the different structure of its keel.

Only one specimen of this species is in our Museum which has been found in the same geological position as the foregoing species, but at another locality, by Dr. Stoliczka.

The general form of the shell is rather depressed, the whorls being much higher than broad. The umbilicus is not very large, flat, surrounded by low, not strictly defined, walls. The largest transverse diameter of the whorls is nearly in the middle of the sides, and from that point the sides slope gradually and regularly towards the umbilicus as well as towards the siphonal part.

The shell is covered all over with strong radial ribs, which are, however, not very broad, leaving a broad smooth space between them. They start from the umbilicus as high narrow ridges, going nearly straight and radially to the middle of the sides, then turning a little towards the front divide into two or take a new and shorter rib between them; some remain entirely undivided. The ribs of both sides unite on the siphonal edge of the shell in high, sharp, crest-like tubercles, which form a strongly serrated keel. This keel is, as far as I can observe, not divided by a shelly layer from the inner space of the whorl, but is in its construction perfectly like the keel in the greater number of Ammonites. Thus this species does not belong to Quenstedt's group of the "Dorsocavati."

Though the shell is partly preserved in the specimen serving for description, yet the concentric striæ, which come out so strongly in the foregoing species, are very slightly marked in the present one, only causing a slight granulation on the top of the ribs, and not appearing at all in the broad flat spaces between them.

The lobes cannot be observed, as three quarters of the last whorl belong to the body-chamber, and the air-chambers, which follow them, are quite compressed.

The dimensions of the specimen are—

Diameter	of the shell, about	116 mm.
„	of the umbilicus	22
Height	of the aperture from the umbilical suture	53
„	of the „ from the preceding whorl	35
Thickness	of the „	34·5

Remarks.—The specimen serving for description is preserved in sphærosiderite, is mostly a cast, and was found by Dr. Stoliczka at Gudjinsir in the beds with *Pelt. athleta.*

As I have already stated above, the species is very nearly allied to *Amalth. polygonius,* Ziet, and in its general appearance the affinity is striking, but on closer examination both species are easily distinguishable by the stronger and scarcer ribs, and the absence of spines in the middle of the sides of the whorls in the Indian Ammonite.

It is strange, however, to observe that in two shells so closely allied, as in *Amalth. polygonius* and *Amalth. Schaumburgi,* the one belongs to Quenstedt's *Dorsocavati,* whilst in the other the hollow keel is perfectly wanting. This difference may possibly show that the peculiarity in the keel is not of so great an importance as might be supposed.

Though the specimen here described has the greater part of the body-chamber yet preserved, no alteration can be remarked between the sculpture of the latter part and that of the air-chambers.

GENUS *HAPLOCERAS*, ZITTEL.

There have as yet been found only three specimens of this rare genus in the jurassic strata of Kachh, one of them not in a sufficient state of preservation to admit of an accurate determination, though it seems very probable that it belongs to *Haploceras tomephorum*, Zitt. The other is a new species, which I shall describe under the name of *Hapl. deplanatum*. Both are found in the ferruginous sandstones of the Katrol group. The third is of nearly Oxfordian age, and represents also a new species. Each of these species belongs to a different group of forms, and thus the genus, though it only furnished three species, is yet pretty well represented in the Kachh Jura.

Haploceras, characterized by smooth whorls, short body-chamber, eared mouth, and incisions on the siphonal side of the body-chamber, can, by a little care, be easily recognised even in small fragments by the smooth surface, the rounded siphonal side, and the strongly falciform striæ of growth on the shell, which characters never occur together in other groups of Ammonites.

(a.) Group of HAPLOCERAS RASILE, *Opp.*

1. HAPLOCERAS *cf.* TOMEPHORUM, *Zittel.* Pl. VII, Fig. 4*a*, *b*.

1865. *Ammonites incultus*, Oppel: Zeitschr. d. deutsch. Geolog. Ges., Vol. xvii, p. 552, (non *Amm. incultus*, Beyr).

1870. *Haploceras tomephorum*, Zittel: Fauna der älteren cephalopoden führenden Tithonbildungen, p. 54, pl. 28, (4), fig. 9.

Though I suppose it to be nearly sure that our example from Kutch belongs to Zittel's species, I will not identify it without reserve, simply because the last part of the last chamber is wanting, and the siphonal lobe is not visible.

The example from Kutch lying before me is a rather small shell of 20 mm. diameter. The whorls are rounded, as broad as high, the umbilicus rather small and deep. There are three lateral lobes on each side, the first lateral lobe being the largest of them, all finishing in one point, the saddles with very little dentation. The siphonal lobe is too badly preserved to ascertain if it was longer or shorter than the first lateral, but it seems that the former was the case. The shell of the inner whorls is covered with fine striae of growth of strong falciform shape.

The dimensions are—

Whole diameter	20 mm.
Height of the last whorl	9
Thickness of the last whorl	9·5
Width of the umbilicus	5

Remarks.—The label attached to this specimen says: "From a gritty rag bed above the great thickness of clays and shales forming scarp of hills in 'Section S.' of Bhoojooree.—From the highest beds containing Ammonites in Katrol range at Juddoora, south of Bhooj."

The genus *Haploceras* begins in Europe in Inferior Oolite strata, and is there represented by three species; in the Bathonian there are two; in Kelloway strata one; the same in Oxfordian, one; in Kimmeridgian, one;* in the Tithonian formation, eleven; in the Neocomien again, two; it is therefore evident that the genus has its greatest development in the Tithonian age. If we look through all the species, we find that on account of the sutures and the section of the whorls, only two can be compared with our specimen; those are *Hapl. rasile*, Opp., var. *inflata*, Zitt., and *Hapl. tomephorum*, Zitt. After a most careful examination of all the valuable points, I come to the conclusion that most likely the example here existing belongs to the latter species. I regret very much that the bad state of preservation of this example does not allow me to state the determination with all certainty.

It is of great importance that this specimen comes "from the highest beds containing Ammonites," and that it represents a Tithonian form. It would be too much to assign for this reason to the strata containing this fossil without doubt a Tithonian age, but it is certainly remarkable that the youngest beds, containing Ammonites in Kutch, have furnished a fossil of a type which in Europe also signifies the youngest jurassic fauna. But there is yet another specimen coming from the same locality and layer preserved in our Museum which represents another species, but also of a Tithonian type. I shall describe the species accurately on one of the next pages under the name of *Asp. Wynnei.*

The rock which contains the specimens is a red marly sandstone, with large grains of quartz.

(b.) Group of HAPLOCERAS PSILODISCUS, *Schloenbach.*

1. HAPLOCERAS DEPLANATUM, *Waagen, n. sp.* Pl. XI, Fig. 9*a*, *b*, *c*.

The species is very much allied in its general form to *Hapl. Erato*, Orb., but can be distinguished easily by its flatter shape.

The cast, which alone I have for description, is flat, disciform, with a tolerably wide umbilicus and rounded siphonal sides. The sides of the whorls, though flattened, are, however, not strictly level, but rounded in a very depressed arch. The umbilicus is shallow, surrounded by rather steep walls, which pass into the sides of the whorls without forming an umbilical edge. The siphonal side is narrow, but perfectly rounded.

The lobes are rather short and broad, but do not exceed the limits of variability as exhibited by the other species of the genus. Their general type somewhat recalls *Hapl. elimatum*, Opp., or *Stasczyi*, Zeuschn. The siphonal lobe is very short, with two small terminating branches, the external saddle low, with a small secondary lobe in the middle. First lateral lobe the longest of all, nearly twice as long as the siphonal, with broad body and with one terminal and three lateral branches. First lateral saddle going high up, higher than all the others, with a secondary lobe in the middle. Second lateral lobe shorter than the first, unsymmetrical. Three auxiliary lobes as far as the umbilical suture.

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* Since this was written Dr. Neumayr has described several other Kimmeridgian species.

The dimensions are the following:—

Diameter of the shell	27 mm.
„ of the umbilicus	6
Height of the aperture from the umbilical suture	14
„ of the „ from the preceding whorl	11
Thickness of the „	8

Remarks.—The only specimen existing of this species was found on the road to the Charvar range, south of Bhooj, in the sandstones of the Katrol group. Though small and without body-chamber, it is a characteristic and well preserved specimen.

Hapl. deplanatum is at a first glance not easy to distinguish from the other smooth forms with complicated lobes, and principally *Hapl. psilodiscus*, Schloenb., and *Hapl. Erato*, Orb., are very nearly allied to the Kachh species. The former, however, can be distinguished by a somewhat smaller umbilicus and lobes, in which the first lateral saddle is without secondary lobes. *Haploceras Erato* has a larger umbilicus and thicker whorls. *Hapl. deplanatum* is in general next to *Hapl. psilodiscus* the flattest and thinnest species of the whole genus. From all the allied forms of the Tithonian formation, our species is also distinguishable by more simple lobes.

Hapl. deplanatum is in every respect the connecting link between *Hapl. Erato* and *Stasczyi*. Whilst in Europe the series seems rather broken,—as there, in Kimmeridgian beds, the genus is only represented by *Hapl. falcula* and *Wentzeli*, which do not well fit into the series,—the connection is completed by the Indian species, which keeps also a geological position between Oxfordian and Kimmeridgian formations.

(c.) Group of HAPLOCERAS FIALAR, *Oppel.*

1. HAPLOCERAS PROPINQUUM, *Waagen, n. sp.* Pl. XI, Fig. 4*a*, *b*.

This species is very nearly allied to *Haploceras Fialar*, Opp., and possibly yet more to *Hapl. tenuifalcatum*, Neum., but the latter species is very difficult to recognise from the brief description given in the Verhandlungen of the Vienna Geological Institute.

The general form of the shell is flat, discoid, with compressed, rounded whorls and a widely open umbilicus. The siphonal side shows a rounded edge, without keel or tubercles. The whorls are nearly entirely smooth up to a diameter of the shell of about 30 to 35 mm., but in larger specimens the sides of the whorl are provided with thin, sharp, curved ribs, which begin near the siphonal margin and go down to the middle of the sides, where they meet a shallow canal, near which they terminate again. From the canal the shell gradually descends towards the umbilical suture, and, showing not a trace of any ribs, is only covered with faint striæ of growth, directed obliquely with a slight curve towards the mouth of the shell. The body-chamber, however, is not preserved.

The inner whorls, though apparently smooth, show also very fine and numerous curved ribs on the outer half of their sides, towards the siphonal part, visible if the specimen be held so that the light is reflected; but there never is any trace of a canal visible. The umbilicus in young specimens is a little deeper and surrounded by an obtuse umbilical edge.

The lobes are not very well seen, but one can observe that the siphonal lobe is very short, also the external saddle. The first lateral lobe is rather long, not very much ramified; the first lateral saddle goes up very high, and is unsymmetrical. The second lateral lobe is very small. There are four auxiliary lobes.

The dimensions are—

Diameter of the shell	50 mm.
„ of the umbilicus	13
Height of the aperture from the umbilical suture	22
„ of the „ from the preceding whorl	16
Thickness of the „	11

Remarks.—The only full grown specimen of this species was collected by Dr. Stoliczka at the south side of Keera hill near Charee, in whitish shales with ferruginous nodules, with many quartz grains, immediately above the oolite, with *Aspidoc. perarmatum.*

The species is not difficult to distinguish from any other known. Among European species *Hapl. Fialar* is the most nearly allied to it, but is distinguishable by its more curved ribs and the tubercles on the siphonal side. Neumayr's *Hapl. tenuifalcatum* may even be identical with our species, yet as he distinctly states that there is no canal on the sides of the whorls, but does not give the diameter of the shell at which the canal is wanting, I cannot identify the Indian species with that from Transilvania.

Certain species of *Harpoceras* also resemble very much *Hapl. propinquum,* principally some varieties of *Harp. Brighti,* Pratt, but as this species has in young specimens already a pronounced sculpture and a rather deep canal, the Kachh form may be easily separated.

The two most nearly allied species of Europe above mentioned belong both to the zone of *Oppelia tenuilobata.* Very nearly the same seems to be the position of the Indian form at the base of the Katrol group, *viz.,* Upper Oxfordian or Lower Kimmeridge.

GENUS *OPPELIA*, WAAGEN.

This genus, proposed by myself in 1869, is in Europe chiefly characteristic for the Malm formation. We should therefore expect its representation also in the Kachh Jurassic strata, and accordingly not less than ten species of the genus have been successively discovered.

They begin in Kachh below the beds with *Steph. macrocephalum*, are most numerous in species in the beds with *Perisph. arthriticus* and *Pelt. athleta*, and are yet represented by four species in the Katrol group. All, except one, belong to groups of forms which also occur in Europe, and several are identical with European species.

The origin and grouping of the species of the genus *Oppelia* I have discussed already at length in a former memoir, (Die Formenreihe des Amm. subradiatus, Benecke, Geogn. Pal. Beitr., Vol. II), and therefore I shall be brief here on this point.

There are four principal groups of forms represented among the Kachh species: the group of *Oppelia subradiata*, Sow., by *Opp. subcostaria*, Opp., *Opp.* cf. *glabella*, Leckenby, and a fourth species out of the bed with *Pelt. athleta*, which is, however, represented in our Museum only by two body-chambers in too bad a state of preservation to admit of accurate determination or description. There is a group of entirely Indian distribution, the group of *Oppelia fornix*, Sow. It forms a kind of transition from *Harpoc. hecticum* to *Oppelia*, and is represented in Kachh by *Opp. fornix*, Sow., and *Opp. Nurrhäensis*, Waagen, n. sp. The group of *Oppelia superba*, Waagen, represented by *Oppelia bicostata*, Stahl. The group of *Oppelia flector*, Waagen, with *Oppelia trachynota*, Opp., and *Opp. Kachhensis*, Waagen, n. sp. Group of *Oppelia subtililobata*, Waagen, by *Opp. plicodiscus*, Waagen, n. sp., in the Kachh Jura.

Two other groups deviate from the typical forms of *Oppelia* by a wider umbilicus and depressed whorls; they are the groups of *Oppelia lingulata*, Quenst., and of *Oppelia* (*Oecotraustes*) *genicularis*, Waagen, the first represented in Kachh by *Oppelia plana*, Waagen, n. sp., and the other by a compressed and not well preserved specimen, a species very likely identical with *Opp.* (*Oecotraustes*) *serrigera*, Waagen.

An isolated form of only Indian occurrence is *Oppelia orientalis*, Orb.

The species identical with European forms are, as in the other genera, distributed geologically quite in the same way as in Europe: *Opp. subcostaria* is associated with *Steph. macrocephalum*, *Opp. bicostata*, Stahl., with *Peltoc. athleta*, *Opp. trachynota* with *Aspidoc. iphiceroides*. But not only do the identical species show the same geological distribution, there are also some analogous forms which represent European species in corresponding beds; thus *Opp. Kachhensis* replaces *Opp. compsa*, Opp., *Opp. plicodiscus* replaces *Opp. tenuilobata*, and *Opp. plana* replaces *Opp. modestiformis* of Europe in the Katrol group.

It is also of interest that the *Aptychus*, characteristic of the genus *Oppelia*, has also been found in Kachh. One specimen of rather considerable dimensions is preserved in our Museum as coming from Kachh, but no exact locality is indicated. The specimen is preserved in a ferruginous sandy rock, and has been collected very likely in beds of the Katrol group.

(a.) Group of OPPELIA SUBRADIATA, *Sow., sp.*

1. OPPELIA SUBCOSTARIA, *Opp. sp.* Pl. X, Figs. 1, 1*a*, 2, 2*a*.

1857. *Ammonites flexuosus macrocephali*, Quenst.: Der Jura, p. 482, pl. 64, figs. 7, 8.
1862. „ *subcostarius*, Oppel: Palæontolog. Mittheilungen, I, p. 149, pl. 48, fig. 2*a*, *b*.
1869. *Oppelia subcostaria* (Opp.) Waagen: Geognost. Palæontolog. Beitr. v. Benecke, Schlönbach und Waagen, II, p. 219, pl. 19, figs. 2—5.

The description I have given in the paper quoted above is, I think, detailed enough to enable every one to recognise the species; thus I can be a little more brief here on this point and restrict myself to the Indian specimens.

In young examples one can distinguish, as in Europe, two varieties which seem at first view of two very distinct species; I myself was for a long time inclined to consider them as different. The Indian examples are, however, very well adapted to show that this is not the case. I have on pl. x, figs. 1 and 2, figured two examples, the first half of the last whorls of which show each one of the two varieties. In fig. 1 the younger states of growth are commonly very smooth; one remarks only a very little elevated spiral ridge on the middle of the sides. From there a few rather strong falciform ribs turning against the outer margin are visible, between which along the outer margin a greater number of very short fine ribs appear. Those latter, however, become slighter and slighter as the specimen grows large, and disappear entirely at a diameter of the shell of about 50 mm., so that only the stronger, falciform ribs still exist; and then the shell has attained its typical form. This is exactly the variety I have figured in pl. xix, fig. 3, of my former paper.

The other drawing, fig. 2, pl. x, shows the first half of the last whorl covered with rather strong, equal, falciform ribs, each of them terminating on the outer margin with a rounded prominent point. The points gradually disappear, the ribs become more distant, and at a diameter of about 55 mm. the specimen attains throughout the same typical form as the other variety. The Indian specimen is the first full grown example of this variety I have been able to examine; at the time I described this species in our Geognostisch palæontologischen Beitrægen I had only one young example from Balin at my disposal, and it was difficult to identify it with the other variety; the Kutch specimen now justifies my former views on this point.

The full grown form of *Oppelia subcostaria* is discoid, with a rather small umbilicus. The siphonal side is in casts always rounded; if the shell is preserved, a slight keel is visible. The sides of the specimens are more or less rounded and bearing slight, distant falciform ribs, of which I count about fourteen on an example of 100 mm. in diameter.

The measurements are—

	I.	II.
Diameter of the shell	63 mm.	97 mm.
„ of the umbilicus	11	13
Height of the aperture from the umbilical suture	34	54
„ of the „ from the preceding whorl	24	36
Thickness of the „	17	27

Remarks.—The specimens now described are both from Keera hill near Charee, preserved in the same beautiful golden oolite in which also the *macrocephali* and the other species characteristic for this zone are preserved; another specimen had been found just at the base of the golden oolite, also at Keera hill. It is of great importance, and especially worthy of remark, that here *Oppelia subcostaria* occurs not only in the same form, but even in the same varieties as in Europe in the same layer. If one remembers how many extremely nearly allied forms exist, and what a little change would be sufficient to enable one to consider it as a different species, it is really astonishing that such changes cannot be pointed out. The ancestors of *Oppelia subcostaria* are all found in Europe, and I have formerly shown that the first roots of the species lie there in the inferior oolite in *Oppelia subradiata.* In India we have not yet found a single form like *Opp. subcostaria,* in older layers, and we must therefore presume that this species is of European origin.

2. OPPELIA *cf.* GLABELLA, *Leckenby, sp.* Pl. X, Figs. 7, 7*a*.

1859. *Ammonites glabellus,* Leckenby: Quart. Journ. Geol. Soc., Lond., XV, p. 12, pl. II, fig. 5*a*—*c*.
1866. *Ammonites glabellus,* (Leckenby) Oppel: Geognost. Palæontol. Beitr. von Benecke: Schlönbach u. Waagen, I, p. 215.

The example which represents the species is not very well preserved, and thus not well adapted for an exact determination, but the form deserves to be mentioned as occurring in the Indian Jura.

There are only the body-chamber and the last air-chamber preserved in the specimen I have for description.

The body-chamber occupies a little more than a half of the last whorl, is in its beginning still somewhat keeled, but soon loses the keel entirely and gets perfectly rounded on the siphonal side towards the mouth. The sides are flatly rounded with a shallow spiral furrow on the middle. The sides are thus divided into two parts, the inner of which is smooth; the outer is covered by arched ribs, some of which are stronger, principally near the furrow, the others are fainter and shorter, limited to the outer margin.

The lobes are short and very simple, nearly resembling those of *Opp. latilobata,* Waagen. The siphonal lobe is shorter than the first lateral; first lateral saddle divided by a secondary lobe, similar to the external saddle. Three auxiliary lobes.

The dimensions are—

Diameter of the shell	...	...	...	...	...	...	68 mm.
" of the umbilicus	...	...	...	...	...	...	6
Height of the aperture from the umbilical suture				...	...	...	34
" of the " from the preceding whorl				...	...	...	22
Thickness of the "	...	...	...	...	...	...	20

Remarks.—The only specimen existing of this species was found at Keera hill near Charee, very likely in the bed of *Peltoc. athleta,* and is preserved in a gray marl nodule.

In Europe *Opp. glabella* is a species of Lower Oxfordian age, and thus the species would occupy a somewhat lower position in the Indian Jura.

There is yet another species belonging to the group of *Opp. subradiata,* preserved in our Museum, but the materials which exist—two body-chambers—are not sufficient to allow of an exact determination. The species reached a diameter of about 100 mm., and the specimens resemble in some respects the body-chambers of small specimens of *Opp. subcostaria,* but the umbilicus is much larger.

Both specimens are preserved in gray marl nodules, with the shell black in colour, and were found one in the zone of *Pelt. athleta,* north-east of Gudjinsir, the other in the same bed south-east of Nurrha.

(b.) Group of OPPELIA FORNIX, *Sow.*

1. (?) OPPELIA FORNIX, *Sow.* Pl. XIV, Figs. 7—7*a*.

1840. *Ammonites fornix,* J. de C. Sow.: Transact. Geol. Soc., Lond., Vol. v, pl. 61, fig. 13, and expl.
1871. *Harpoceras fornix,* (Sow.) Waagen: Records. Geol. Surv. of India, Vol. iv, p. 91.

This species seems to be one of the rarest in the Kachh Jura, as even in the very rich collections of fossils which have been at different times obtained by our Museum not a single specimen of this species is preserved. But I have been obliged to change the generic designation of *Amm. fornix* from *Harpoceras* into *Oppelia,* as the species shows great analogies to *Oppelia Narrhaensis,* which latter could be proved by new material to be an *Oppelia.*

To describe the species I can do nothing but repeat Sowerby's words. He says—"Discoid, depressed, (when young, keeled), undulated; inner whorls ⅓ exposed, their exposed parts smooth; margin convex, smooth, with a row of minute tubercles on each side and a slender keel, which are lost in the external whorls; undulations bent back in the middle of the sides, divided towards the margin;

aperture sagittate elliptical. Diameter two inches, width of the aperture seven lines; its length one inch two lines."

Remarks.—The species is very peculiar in its shape, and has no representative whatever as yet in the European Jura. It is very nearly allied to the following species, and forms together with it a well characterised and easily distinguishable group.

2. OPPELIA NURRHAENSIS, *Waagen, n. sp.* Pl. XI, Fig. 2*a*, *b*; Pl. XIV, Figs. 3, 3*a*, 3*b*, 4, 5, 6, 6*a*.

1871. *Harpoceras Nurrhaense*, Waagen: Records, Geol. Surv. of India, Vol. iv, p. 91.

Very good materials of this species were brought back by Stoliczka from his geological tour in Kachh, among others, a full grown specimen with entirely preserved body-chamber, which causes me to transfer the species from the genus *Harpoceras* to *Oppelia.*

The shell in its general appearance and its variability most nearly resembles *Opp. fusca*, Quenst., among European species.

The outer form is discoid, compressed, with tolerably flat sides, a keeled siphonal side on the air-chambered part of the shell, a rounded one on the body-chamber, and a tolerably wide umbilicus. The sculpture is extremely variable, just as much and even more so than in *Oppelia fusca.* It is always composed of strongly curved, falciform ribs, which, however, are sometimes very numerous, sometimes scarce, sometimes provided with little tubercles on the outer margin, sometimes not.

The early stages of growth up to a diameter of 4 mm. are entirely smooth, with depressed rounded whorls without keel. The keel appears at about 7 mm. diameter, the ribs yet later, and often specimens of 15 mm. are still without them. When they appear, the outer part of them, going from the middle of the sides in a strong semicircular curve to the siphonal margin, is first visible; the inner part remains commonly very faint, is strongly directed towards the front, and corresponds with two or three of the outer ribs.

The permanent form of the shell appears only at a diameter of 35 to 40 mm. In specimens which were densely ribbed up to that size the ribs become thin, more distant at equal intervals, sharper and more regular; other varieties change their sculpture to about the same effect; but only the outer part of the ribs is well developed, the inner part is barely visible. On the body-chamber the ribs disappear entirely, and the shell is there densely covered with strong striæ of growth; the aperture is not well preserved, but it can be seen that it was slightly falciform with a rounded ventral prominence. There is, therefore, no doubt that the species belongs to the genus *Oppelia.* The umbilicus is about one-fifth of the diameter of the shell, and is surrounded by curved walls.

The lobes are very simple, and in adult specimens very characteristic. The siphonal lobe is broad, short, and divided into two short branches; external saddle tolerably broad, with a very small secondary lobe; first lateral lobe much longer than the siphonal, very little divided; first lateral saddle very broad, going very high up and divided into two unequal parts by a small secondary lobe; second lateral lobe very much like the first, but much shorter; second lateral saddle symmetrical, and somewhat shorter than the first; four auxiliary lobes up to the umbilical suture.

The dimensions of three specimens are—

	I.	II.	III.
Diameter of the shell	22 mm.	39·5 mm.	80 mm.
„ of the umbilicus	7	9	14
Height of the aperture from the umbilical suture	9	19	40
„ of the „ from the preceding whorl	7	14	27
Thickness of the „	6·5	11	19

Remarks.—The species is commonly found in shales with nodules of Hæmatite, between the beds of *Steph. macrocephalum* and of *Pelt. athleta*, corresponding to the European zone of *Perisph. anceps.* In this position it has been collected east of Nurrha, north-west of Jumara, and at Keera hill near Charee. The species seems to have been a gregarious one, as commonly several specimens are obtained out of one and the same nodule.

Among the Indian forms, which are allied to *Opp. Nurrhaensis*, *Oppelia fornix*, Sow., can most easily be mistaken for it, but higher more compressed whorls, straighter ribs, and the absence of fine tubercles or spines near the siphonal margin in *Opp. Nurrhaensis* always enable us to distinguish both species.

Of European species only *Opp. fusca* seems really very much allied in its form to *Oppelia Nurrhaensis*, but our species has straighter ribs, a larger umbilicus, and quite different lobes.

(c.) *Group of* OPPELIA SUPERBA, *Waagen.*

1. OPPELIA BICOSTATA, *Stahl.* Pl. XI, Fig. 1*a*, *b*, *c*, *d*.

1824. ***Ammonites bicostatus***, Stahl: Württemb. landwirthschaftl. corresp. Bl. for 1824, p. 49, fig. 9.
1831. ***Ammonites bipartitus***, Zieten: Verst. Württemb., p. 18, pl. 13, fig. 6.
1831. ***Ammonites calcar***, Zieten: *l. c.*, p. 18, pl. 13, fig. 7.
1846. ***Ammonites bipartitus***, (Ziet.) Quenstedt: Cephalop., p. 139, pl. 10, fig. 8.
1846. ***Ammonites bipartitus*** (Ziet.) Orbigny: Pal. Franç. Terr. Jurass., I, p. 443, pl. 158, figs. 1—4.
1857. ***Ammonites bicostatus***, (Stahl.) Oppel: Jura form., p. 560.
1858. ***Ammonites bipartitus*** (Ziet.) Quenstedt: Jura, p. 590, pl. 70, fig. 11.
1869. ***Ammonites bicostatus***, (Stahl.) Waagen: Benecke's Geognost. palæont. Beitr. II, pp. 192 and 222.

One of the most beautiful forms of the Upper Callovian beds. The general shape of the species is tolerably flattened, with flatly rounded sides, a rather shallow umbilicus, and a flat siphonal part, which is limited on each side by a dentated ridge and provided in the middle with a sharp keel, which disappears, however, on the body-chamber, and is there replaced by a shallow groove.

The sides of the whorls are covered with faint falciform ribs, which are flattened on the outer curved part, and sometimes even provided with a longitudinal groove on the top, and terminate in a dentation of the ridge along the siphonal part of the shell. Along the middle of the sides there is a faint canal accompanied on the side towards the umbilicus by a low rounded ridge. The inner part of the falciform ribs lies between this and the umbilical margin, but is mostly so faint that it is visible only on comparatively large specimens. The dentations on both sides of the siphonal part consist of fine flat compressed tubercles, but those on one side do not correspond with those on the other, but alternate with each other. At the beginning of the body-chamber this alternation is, however, no more so constant or distinct.

Young specimens up to a diameter of about 14 or 15 mm. are entirely smooth, except the dentations along the siphonal part and the keel, which are very prominent. At a diameter of about 20 mm., the ribs on the sides of the whorl become distinct and remain visible until the end of the body-chamber; the dentations, however, disappear at the beginning of this last part of the shell. The length of the body-chamber is about one-half of the last turn. The aperture is not preserved.

The lobes are simple. The siphonal lobe very short, external saddle also rather short, unsymmetrically divided into two parts by a small secondary lobe; first lateral lobe long with slightly ramified partitions; first lateral saddle broad, going high up, with two very small secondary lobes; second lateral lobe very small and short; there are yet three auxiliary lobes separated from each other by rather broad saddles.

The dimensions are—

Diameter of the shell	58 mm.
„ of the umbilicus	13
Height of the aperture from the umbilical suture	27
„ of the „ from the preceding whorl	19
Thickness of the „	18

Remarks.—The only specimen of this species was found south-west of Barasore on the south side of Charvar range in the bed with *Peltoc. athleta*, and is preserved in a gray, very hard marl nodule.

Oppelia bicostata is one of the most characteristic fossils of the zone of *Peltoc. athleta* in Europe, and its occurrence of exactly the same form and in the same position here in India is of the highest scientific interest. It shows clearly how the faunæ of even minute geological horizons are spread over half the world, and how species observed as associated in one place maintain this association even in the remotest districts.

(d.) Group of OPPELIA FLECTOR, *Waagen.*

1. OPPELIA TRACHYNOTA, *Opp.* Plate X, Figs. 6, 6*a*.

1863. *Ammonites trachynotus*, Oppel: Palæontolog. Mittheilungen, I, p. 214, pl. 56, fig. 4*a*, *b*.
1870. *Oppelia trachynota*, (Opp.) Zittel: Fauna d. ält. Cephalop. führend. Tithonbild., p. 70, pl. 5, fig. 3.

This species is very difficult to recognise in a stage of growth younger than are the examples which lie before me. If the body-chamber, which in the *Flexuosi* always gives the best points to recognise the species, is wanting, only with great care is it possible to attribute the inner whorls to one or the other species.

Zittel *(l. c.)* has figured a good and sufficiently characteristic specimen of the species, and a comparison of our figure with his drawing will show more easily than any description that the Kachh specimen belongs to the species. The young examples of *Opp. trachynota* show a rather small umbilicus. The sides of the whorls are more or less rounded and fall with a sharp edge, a little bending inside, towards the umbilical suture. They are covered with not very numerous flexuose ribs, which terminate on the outer margin with strong prominent tubercles, of which I count about twenty-one on one whorl. The siphonal side is rounded, and bears in the middle a row of small and numerous tubercles, which are very easily destroyed by the action of the weather. The sutures very much resemble the usual lobes of the *Flexuosi* in their general form. We count five lateral lobes, the first one being by far the largest. The siphonal lobe is very short, divided into two short branches. The external saddle is also short, and divided by a small secondary lobe; the first lateral saddle very long, longer than all the others.

The dimensions of one of my examples are—

Diameter of the shell	66 mm.
" of the umbilicus	10
Height of the aperture from the umbilical suture	34
" of the " from the preceding whorl	23
Thickness of the "	21

Remarks.—One of the examples now before me is from Kuture (Joora hills), collected by Mr. Blanford; the other from the 'Ammonite-bed (*i. e.*, in which Ammonites are plentiful)' in the section east of Lair, on the north base and scarp of Katrol range. It is true Ammonites must be very common here, because there are a great number of those fossils from the same locality and layer preserved in the Museum. They all belong to the genus *Perisphinctes*, and resemble very much forms which in Europe mark layers of higher Oxfordian or Kimmeridgian age. The species of the group of *Macrocephali*, the *Perisphinctes* of middle oolitic types, the *Harpoceras* and *Haploceras* are wanting throughout, so that it is very probable that we have here a layer quite different both in the quality of rock and in age from the golden oolite of Cheree. *Oppelia trachynota* is in Europe very characteristic for the higher part of the Upper Jura, *i. e.*, from the Kimmeridge group upwards, and the society in which the species is found at Lair does not oppose the supposition that it may be here of similar age.

The rock in which are preserved both examples of *Oppelia trachynota* in the Joora hills, as in the Katrol range, seems to be a reddish marly layer with many grains of quartz and very hard concretions, containing mostly the fossils.

Oppelia trachynota is distinguishable from the allied forms by its not very high whorls and the very strong and prominent ornamentation.

2. Oppelia Kachhensis, *Waagen*. Plate X, Figs. 4, 4*a*, 4*b*.

I doubted for a long time whether I should separate this species from *Oppelia compsa*, to which it is extremely nearly allied; but considering that identifications between Indian and European species are of great scientific consequence, and that one must therefore be doubly careful in identifying the fossils, I preferred to describe the specimens under a new name, instead of putting them together with a well known European form without sufficient certainty.

The description of the species is very difficult. The young stage is covered with distinct flexuous ribs, of which every second one bears on its termination on the siphonal margin a rather strongly rounded tubercle. After having attained a diameter of 55 mm. the shell becomes successively smooth, by the disappearing of the ribs, the tubercles become scarce, and take exactly double the distance from each other than the tubercles in *Oppelia compsa* do; whether the body-chamber is differently ornamented from the other whorls I cannot state, as the largest example I have at my disposal, having a diameter of 105 mm., shows sutures to the end. The siphonal side of the shell is rounded, and in the younger stages of growth ornamented in the middle with small, closely arranged, rounded tubercles, which disappear absolutely in larger examples. The sutures are not very finely dentated, but are of the form usual in the *Flexuosi*.

The dimensions are—

Diameter	of the shell	84 mm.
„	of the umbilicus	12
Height	of the aperture from the umbilical suture	46
„	of the „ from the preceding whorl	35
Thickness	of the „	26

Remarks.—I have here four specimens of *Opp. Kachhensis* for examination. All are from east of Lair on the north base of Katrol range, from the same bed as the preceding species—the 'Ammonite-bed' of the section there.

The type represented by the species is quite of Kimmeridgian aspect, and if such a form were found in European strata, one would without doubt attribute the layers containing it to the Kimmeridge group of the upper Jura.

(e.) Group of OPPELIA SUBTILILOBATA, *Waagen.*

1. OPPELIA PLICODISCUS, *Waagen.* Plate X, Figs. 5, 5*a*.

The only example of this species existing is a young one, not exceeding a diameter of 30 mm., but nevertheless it represents without doubt a species different from all as yet described, but certainly nearly allied to *Opp. tenuilobata.*

The specimen has for an *Oppelia,* and principally for a form of the group of *Opp. subtililobata,* rather thick rounded whorls. On the middle of the sides is a flat spiral furrow, often somewhat interrupted by irregular falciform ribs, which partly pass through it and partly are interrupted. The outer part of these radial ribs is a little thickened and more like a flat elongated tubercle.

The siphonal side is rounded, and on the cast is without visible keel. On both sides on the siphonal margin there are a great many very fine short ribs which are so characteristic for the whole group of *Opp. subtililobata.* The sutures are, notwithstanding the small dimensions of the specimen, very finely dentated. The siphonal lobe is very short; the first lateral is the longest of all, terminating in three branches; the second lateral is very much like the first, but much shorter; there are yet six or seven auxiliary lobes visible. The external saddle is, like the first lateral, divided into two parts by a small secondary lobe; the first lateral saddle does not go much farther up than all the other saddles.

The dimensions are—

Diameter of the shell	31 mm.
„ of the umbilicus	4
Height of the aperture from the umbilical suture	17
„ of the „ from the preceding whorl	10
Thickness of the „	9

Remarks.—The example I have for description is from south of Madapoor; it is preserved in a yellowish gray marly concretion very much like some *Perisphinctes* of upper jurassic type. I thought it of some interest to describe the species, though only one example is preserved, because this type in Europe is very significant for upper jurassic layers. The developmental series to which the species belongs begins in the uppermost layers of the Callovien and finishes in the Tithonian group.

(f.) Group of OPPELIA LINGULATA, *Quenst.*

1. OPPELIA PLANA, *Waagen, n. sp.* Pl. XI, Fig. 3*a*, *b*.

Like all the species of the whole group, *Opp. plana* also has a very simple form.

The general shape is flat, discoid, with compressed whorls, wide umbilicus, and rounded siphonal side. The sides of the whorls are smooth without any ribs, but on their middle a rather broad strong canal runs along as in *Oppelia modestiformis.* The widely open umbilicus is surrounded by perpendicular walls, which pass without forming an umbilical edge into the sides of the whorl.

The lobes are very simple and barely ramified; the siphonal lobe has two very short branches, and is short and broad; the external saddle is also very short; a secondary lobe in it very little developed; first lateral lobe a good deal longer than the siphonal, terminating in three short branches; first lateral saddle going a little higher up than the external, second lateral lobe, comparatively very small: two auxiliary lobes as far as the umbilical suture.

The dimensions are—

Diameter of the shell	26 mm.
„ of the umbilicus	8
Height of the aperture from the umbilical suture	10
„ of the „ from the preceding whorl	8
Thickness of the „	6

Remarks.—There is only one specimen of this species preserved in our Museum which was collected in the sandstones of the Katrol group south-west of Nurrha.

Though the specimen is somewhat broken, yet I thought it advisable to describe it under a new name, as its form is characteristic, and the occurrence of a species allied to *Opp. modestiformis* in the Katrol group is of importance.

Opp. plana is, as already remarked, most nearly allied to *Oppelia modestiformis*, Opp. It can, however, easily be distinguished from this species by its much wider umbilicus and a little less compressed whorls. *Opp. lingulata* which also could be mistaken for our species, has much thicker and rounder whorls.

(g.) *Group of* OPPELIA (OECOTRAUSTES) GENICULARIS, *Waagen.*

1. OPPELIA (OECOTRAUSTES) *cf.* SERRIGERA, *Waagen.* Pl. X, Fig. 3.

1869. *Ammonites (Oecotraustes) serrigerus*, Waagen: Geogn. Palæont. Beitr. von Benecke, Schlönbach u. Waagen, Vol. ii, p. 230, pl. 20, figs. 7 and 8.

In order to give an exact idea of the real composition of the extinct cephalopodous fauna of a certain country, it is necessary to mention even bad specimens so long as it is possible to indicate the position they may obtain among the other already described species. This was already the case in a certain degree with *Opp. glabella* before described, and it is yet much more the case with the species now mentioned.

The examples lying before me are three; all three on one slip of a gray, very hard sandy shaly rock from the south of Nurrha. They are quite compressed, and the best preserved of them which is figured on pl. X, fig. 3, is only a flat impression of the shell in the rock. But even in this state of preservation no one will doubt, even in looking at the figure, that it belongs to the section *Oecotraustes* I have formerly described; the want of the tubercles on the inner whorls and on the last part of the last whorl, as well as the deviation of the regular spiral, are evidence to this position. The species, however, is doubtful. As far as one can observe, it shows mixed characters of three species, *Opp. subfusca, serrigera,* and *conjungens,* but the general form seems to me most nearly allied with the Bathonian species, *Opp. serrigera* and *subfusca.* The diameter of the largest example is 44 mm.

ISOLATED FORM.

OPPELIA ORIENTALIS, *Orbigny.* Pl. XI, Figs. 5*a*, *b*, *c*, 6; Pl. XII, Figs. 8, 8*a*, 8*b*.

1840. *Ammonites corrugatus,* J. de C. Sow.: Transact. Geolog. Soc., Lond., Vol. v, pl. 23, f. 12, and expl. (*non* Sow. 1824, M. C., pl. 451, fig. 3).
1850. *Ammonites orientalis,* Orbigny: Prodrome, I, p. 331, Et. 12, Nr. 58.
1871. *Harpoceras orientale,* (Orb.) Waagen: Records, Geol. Surv. of India, Vol. iv, p. 91.

After I had published in the Records of our Survey the sketch of the Ammonites of Kachh, Dr. Stoliczka brought back, among other extensive materials, also an entire specimen of this species from his tour in Kachh, and having found from this that the body-chamber of it is like that of an *Oppelia,* I am obliged to change the name from *Harpoceras* into *Oppelia orientalis.*

The appearance of the full-grown form is entirely different from that of the small specimen I had formerly to examine, but yet it is pretty certain that both belong to the same species.

The inner whorls up to a diameter of about 8 or 10 mm. are entirely smooth, rounded in section, with a barely perceptible keel on the siphonal side. After that rather straight, falciform ribs appear, every one of which is divided into two branches a short distance from the umbilical edge. The branches are a little flattened on their top, have a direction somewhat backward, are very slightly curved, and terminate at the siphonal part of the shell in compressed sharp tubercles, which are placed in a continuous row on both sides of the keel. This form remains until the shell becomes about 20 mm. in diameter. In yet larger specimens the ribs become less numerous and thicker, and at the beginning of the body-chamber, at about 35 to 40 mm. diameter, the keel on the siphonal side disappears, the tubercles on the ribs become indistinct, and the ribs much more strongly curved. The siphonal side of the body-chamber is smooth, only slightly undulated, as in some *Aegoceras.* The aperture is falciform, apparently without ears, and with a rounded ventral process.

The umbilicus is in all stages of growth rather wide, a little less than one-third of the diameter of the shell. It is surrounded by perpendicular walls, which pass, however, into the sides of the whorls without forming a distinct umbilical edge.

The lobes are in neither of the specimens well preserved, but the smaller of both exhibits them to a certain extent at least, so that one can observe that the siphonal lobe is short and broad, also the external saddle; the first lateral lobe is not much longer than the siphonal; the first lateral saddle goes a little higher up than the external; the second lateral lobe is about as long as the siphonal; there are two auxiliary lobes.

The dimensions of the two specimens are—

	I.	II.
Diameter of the shell	19 mm.	52 mm.
„ of the umbilicus	6	15
Height of the aperture from the umbilical suture	8	22
„ of the „ from the preceding whorl	6·5	?18
Thickness of the „	6	17

Remarks.—The specimens I have for description are two; the smaller of them was found at Charee in a yellowish-gray sandy oolite of unknown age; the larger one has been collected by Dr. Stoliczka north-west of Jara in a yellowish-gray, sandy oolite just below the bed with *Peltoceras athleta*, and above the *Macrocephalus* layers. The specimen which has been figured by Sowerby is also from Keera hill near Charee.

Sowerby's figure, given in the Transactions of the Geological Society of London, (Vol. V, pl. 23, Fig. 12,) upon which Orbigny's species is founded, is very bad, and barely to be recognised. The principal features, however, in which also the specimens just described agree with the figure, seem to be that the ribs are divided already near the umbilical margin into two branches, of which, if the specimen is not very much weather-worn, each is provided with a small compressed tubercle, and that there is on the siphonal side of the shell a distinct keel between the two rows of tubercles in young specimens, as one is represented by the drawing of Sowerby.

The species seems barely allied to any European species, except possibly to *Harpoceras hecticum*, with which it has the tubercles along the siphonal side in common. However, in this species the ribs are much more curved, and never divided near the umbilical margin; besides that the body-chamber is quite different.

APTYCHUS. Pl. XI, Fig. 8*a*, *b*, *c*.

Already in my introductory notes to the genus, I have mentioned that an *Aptychus* belonging to the genus *Oppelia* has been found in ferruginous sandy beds in Kachh.

The specimen, though not preserved entirely, has very considerable dimensions; it is 58 mm. long and 33 mm. broad, and must have belonged to a very large individual of *Oppelia*. The outer side is covered by broad, deep folds, comparatively very few in number, which are not quite straight, but a little undulating; the outermost are the broadest. The furrows between the folds are narrow on the upper, and increase in breadth as they approach the lower, part of the shell. On the inner or concave surface, densely arranged plications, running parallel with the outer or curved margin, are visible, which disappear, however, towards the inner edge, leaving a smooth space, upon which three or four extremely faint descending folds are visible radiating from the upper and inner corner of the shell.

No *Oppelia* of so considerable a size as would agree with the size of this *Aptychus*, has as yet been found in Kachh. We may, therefore, expect yet the discovery of another species of *Oppelia* in the Katrol group.

GENUS *HARPOCERAS*, WAAGEN.

I proposed this name in 1869 for all the Ammonites with falciform ornamentation on the shell, distinguishing in the meantime some subgenera, of which one (*Oppelia*) subsequently proved to be of generic value, and as such was entirely separated from the old genus by Zittel and by myself.[*] But even in this new, limited sense, the genus still comprised a very great number of species, by far the largest proportion of which belong to the Liassic period, whilst only comparatively few forms go up to the middle and upper Jurassic. Of the latter one group is principally represented in the Kachh beds,—the group of *Harpoceras hecticum*,—which has furnished not less than seven species, all out of beds from the zone of *Steph. macrocephalum* up to that of *Aspid. perarmatum* inclusive.

Another group is of entirely Indian distribution, as there is no European species of it known. It is the group of *Harpoceras ignobile* with three species, all three found in beds a little older than the zone of *Peltoc. athleta*. *Harp. ignobile* itself is characteristic for this horizon in the Kachh Jura.

There is yet another species, which does not seem to have any relation with any species, as yet published, and which I must consider, therefore, as an isolated form; it is *Harp. Kobelli*, Opp.

The seven species belonging to the first group are—*Harpoceras hecticum*, Rein. sp., *H. punctatum*, Stahl., *H. lunula*, Ziet., *H. vicinum*, Waagen, n. sp., *H. Lairense*, Waagen, n. sp., *H. dynastes*, Waagen, n. sp., and *H. Rauracum*, Mayer. Of these four occur also in the European Jura. *H. hecticum* is found there in the zone of *St. macrocephalum*; *H. lunula* and *punctatum* in the zone of *Perisph. anceps*; *H. Rauracum* in the zone of *Amalth. cordatus*. In Kachh the first of these species occurs also in the society of *St. macrocephalum*; the two next were collected in the beds between that of *St. macrocephalum* and the bed with *Pelt. athleta*, corresponding to the European zone of *Perisph. anceps*: and the last was found in oolite together with *Aspidoc. perarmatum*. Thus the geological position of the identical species is exactly the same here in India as it is in the European strata.

The second group comprises *Harp. ignobile*, Sow., *H. crassefalcatum*, Waagen, n. sp., and *H. trilineatum*, Waagen, n. sp., but no European species.

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[*] Zittel: Fauna d. ält. Cephalop. führenden Tithonbildungen, 1870, p. 57.
Waagen: über die Ansatzstelle der Haftumskeln beim Nautilus und den Ammoniden, Palæontographica, 1870.

(*a.*) *Group of* HARPOCERAS HECTICUM, *Rein. sp.*

1. HARPOCERAS HECTICUM, *Reinecke, sp.* Pl. XII, Figs. 3, 3*a*, 3*b*, 4, 4*a*, 4*b*, 5.

1818. *Nautilus hecticus*, Reinecke: Maris protogaei Nautilos et Argonautas, fig. 34.
1846. *Ammonites hecticus*, (Hartm.) Orbigny: Pal. Franç. Terr. Jurass., I, p. 432, pl. 152.
1857. *Ammonites hecticus*, (Rein.) Oppel.: Jura formation, p. 552.

There are two specimens preserved in our Museum, which may be attributed to Reinecke's species, the one, perfectly agreeing with d'Orbigny's figures 1 and 2, pl. 152, but only lately discovered in the body-chamber of the specimen of *St. macrocephalum* figured on pl. XXV of this volume, and the other one figured on pl. XII and described hereafter. The latter specimen is a fragment of a very large individual, which had barely the aspect of the true *Harp. hecticum*, but having taken out with much labour the inner whorls, I found that it belonged to Reinecke's species.

The inner whorls up to a diameter of the shell of about 40 mm. are a little rounded, squarish, somewhat higher than broad. The sides are covered with rather strong falciform mostly bipartite ribs, which have on the siphonal margin strong elongated tubercles. The siphonal side is strongly keeled, with a very weak, nearly invisible ridge on both sides of the keel; the keel a little granulated.

At larger stages of growth, all the ornamentations of the shell get gradually weaker. At a diameter of the shell of about 80 to 90 mm. flat, falciform ribs are still well visible, but the tubercles at the siphonal margin have already nearly disappeared; they are converted more or less into a weak longitudinal interrupted ridge. The keel of the siphonal side is yet strongly visible, but the grains upon it have become very small and numerous contrary to Orbigny's figure. The ridges on both sides of the keel are still existing; they are covered with fine closely arranged, nearly invisible ribbings in correspondence with the granulations of the keel.

The whole example, of which a fragment is lying before me, had about 180 mm. in diameter. The last whorl is 75 mm. high. The ribs still exist, but they are very flat and indistinct, only the outer part visible. On the cast, the keel of the siphonal side has disappeared, the shell shows yet traces of it. The whorl is covered with lobes up to the end.

The sutures show very characteristically the form which commonly marks the species of the genus *Harpoceras*. The siphonal lobe is very short, broad, and divided into two tolerably long branches. The first lateral lobe is not very long, with broad undivided stem, and terminating in five nearly symmetrical branches. The second lateral lobe is very unsymmetrical. From this up to the umbilical suture there are three auxiliary lobes, and beneath the suture up to the antisiphonal lobe yet two more. The antisiphonal lobe is symmetrical, finishing in one symmetrical finger. Of the saddles, the external saddle has a large secondary lobe, and the first lateral is the longest of all.

Of the dimensions I cannot give more than the height and thickness of every whorl—

Height	of the first whorl	from the umbilical suture	75 mm.
„	of the „	from the siphonal side of the preceding whorl ...	59
Thickness	of the „	... ...	36
Height	of the second whorl	from the umbilical suture	37
„	of the „	from the siphonal side of the preceding whorl ...	29
Thickness	of the „	... ...	25
Height	of the third whorl	from the umbilical suture	14
„	of the „	from the siphonal side of the preceding whorl ...	11
Thickness	of the „	... ...	11

Remarks.—The example described is from the golden oolite at Keera hill near Charee, and occurs here in the society of *Steph. macrocephalum* and the allied species.

It is undeniable that there are some slight differences between our specimen and the figures given by Orbigny and others, consisting in the slight granulations of the keel and the short radial ribs on both sides of it. I may say that it is possible that those differences may indicate a different species, but when one has seen a great many examples of *Harp. hecticum* from numerous European localities, and remarked the great variety of form among them, I prefer to call the Indian form simply *Harp. hecticum*, not asserting, however, that by a careful examination of the European specimens in comparison with the Indian ones, we should not be able to distinguish several species. As our knowledge of those forms now stands, and not having at my disposal very extensive materials, I can do nothing else but abide by the collective name.

Harpoceras hecticum and all the allied forms, with tubercles on the siphonal margin, are in Europe very characteristic for the lower region of the Kelloway group. The society of *Steph. macrocephalum*, in which the species is found in India, seems to indicate for it here also a similar age.

2. HARPOCERAS PUNCTATUM, *Stahl.* Pl. XIII, Figs. 9*a*, *b*, 10.

1824. *Ammonites punctatus*, Stahl.: Württemb. landwirthschaftl. Corresp. Bl., Vol. vi, p. 48, fig. 8.
1830. *Ammonites punctatus*, (Stahl.) Zieten: Verst. Württemb., p. 13, pl. 10, fig. 4.
1846. *Ammonites lunula* (Ziet.) Orbigny: Pal. Franç. Terr. Jurass., Vol. i, p. 439 (pars), pl. 157, figs. 1—4.
1846. *Ammonites hecticus* (Rein.) Quenstedt: Cephalop., p. 117, pl. 8, fig. 1.
1857. *Ammonites punctatus*, (Stahl.) Oppel: Jura form., p. 553.
1858. *Ammonites hecticus lunula*, Quenstedt: Jura, p. 545, pl. 72, fig. 7. (Variety) (non *A. punctatus* (Stahl.) Quenst.: *l. c.* p. 544, pl. 71, fig. 21).

The species, though characteristic and not very difficult to recognise, has yet very often been mistaken, and even in Quenstedt's Jura it is entirely misrepresented. Zieten's figure is excellent, and the species can easily be recognised from it with certainty.

The first stages of growth are flat, with a wide umbilicus, rounded, depressed whorls, a faint keel on the siphonal part of the shell, and more or less smooth sides of the whorls. In specimens exceeding a diameter of 8 or 10 mm. the ornamentation, consisting of strongly bent prominent falciform ribs, is for the most part well developed. The ribs are mostly dichotome, some simple, begin at the umbilical suture with a strong bend towards the front, are highest in the middle of the sides, where they are divided, turn over the back, and reach the siphonal side again with a slight curve towards the mouth of the shell.

The siphonal part of the shell is always provided with a distinct keel even in large specimens. The umbilicus is shallow and wide, the whorls very little embracing.

The lobes cannot be observed on any of the specimens.

The dimensions of two specimens are—

	I.	II.
Diameter of the shell	22 mm.	33 mm.
„ of the umbilicus	8	12
Height of the aperture from the umbilical suture	9	13
„ of the „ from the preceding whorl	7·5	11
Thickness of the „	7	12

Remarks.—The species is represented by two specimens in our Museum, one of which is from Vanda, out of a fine brown oolitic rock immediately above the bed with *Steph. macrocephalum;* the other was found loose on the ground near Barasore, and is preserved also in a fine ferruginous oolite.

The species is very variable, a variation chiefly expressed in the ribs, which are sometimes scarce, sometimes very numerous, sometimes very strong and sometimes much less so; the specimens figured, however, very closely represent the typical form. This variability accounts also for the number of mistakes which have been made in identifying the species. Both Orbigny and Quenstedt have misrepresented the species, Orbigny confounding it with *Harp. lunula,* Ziet., Quenstedt mistaking it entirely, as he identified a variety of *Harp. Brighti* with Stahl.'s species, and united the true *Harp. punctatum* with *Harp. lunula.*

3. HARPOCERAS LUNULA, *Ziet.* Pl. XIII, Fig. 1*a*, *b*.

1830. *Ammonites lunula,* Zieten: Verst. Württem., p. 14, pl. 10, fig. 11, (Reinecke?).
1841. *Ammonites Lonsdali,* Pratt: Ann. and Mag. of Nat. Hist., ser. I, Vol. viii, p. 164, pl. 5, fig. 2.
1846. *Ammonites hecticus compressus,* Quenst.: Cephalop., p. 119, pl. 8, fig. 3.
1857. *Ammonites lunula* (Ziet.) Oppel: Jura form., p. 553.
1858. *Ammonites hecticus compressus,* Quenstedt: Jura, p. 546, pl. 72. fig. 8.
1871. *Harpoceras lunula* (Ziet.) Neumayr: Abh. d. K. K. Geol. Reichsanst., Vol. v, p. 28. pl. ix, fig. 7.

The general form of this species is very much like that of the preceding one, but the whorls are more compressed, the umbilicus smaller, and the whole shell more disciform. Young specimens, however, are difficult to distinguish from specimens of an equal size of *H. punctatum* or any other allied species.

The first stages of growth are entirely smooth, with wide umbilicus and depressed whorls, with a barely visible keel on the siphonal side. But already at a diameter of 5 to 8 mm. the whorls become more compressed and the umbilicus comparatively smaller. On specimens a little larger one can in most cases already distinguish faint ribs on the sides of the whorls, which begin at the siphonal margin, and go in a slight curve to the middle of the sides, where they disappear again. Only in specimens attaining 30 mm. in diameter, the inner part of the falciform ribs lying round the umbilicus becomes visible; this is never very strong, but distinct. One can now distinguish that the ribs begin simple at the umbilical margin, from there are directed towards the front, become very flat on the middle of the sides, and are there divided into two branches.

The umbilicus becomes comparatively smaller as the specimens grow larger, and is, principally in large specimens, surrounded by well defined vertical walls. The siphonal side of the shell is always provided with a distinct keel; however, in casts of very large specimens the keel is lost, or at least not visible.

The lobes are very difficult to observe in the examples I have for examination; however, the principal features can be made out. The siphonal lobe is tolerably broad and short, with two small branches; external saddle very broad, with a small eccentric secondary lobe; first lateral lobe somewhat longer than the siphonal, tolerably broad, little branched, first lateral saddle going a little higher up than the external, rather narrow, with no distinct secondary lobes; second lateral lobe much smaller than the first: there are yet two small auxiliary lobes.

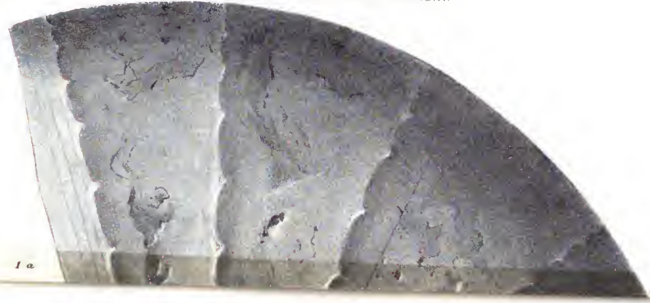
The dimensions of two specimens are—

	I.	II.
Diameter of the shell	42 mm.	55 mm.
" of the umbilicus	12·5	15
Height of the aperture from the umbilical suture	17	24
" of the " from the preceding whorl	?12	18
Thickness of the "	12	14

Remarks.—There are two specimens of *Harp. lunula* in our Museum; both have been found at Vanda in layers between beds with *Steph. macrocephalum* and those with *Peltoc. athleta;* the one of them is preserved in a light coloured oolite, exactly like that of Clucy in the Dép. Jura, which also contains *Harp. lunula* in large quantities; the other came out of a yellow hard marl nodule.

The species characteristic for the European zone of *Perisph. anceps* is tolerably easy to recognise and to distinguish from other allied species. The ornamentation is variable as in *Harp. punctatum,* but the variations are limited to the number and strength of the ribs. The characteristics of the species, which never change, are—a tolerably small umbilicus, ribs, which are strongly curved, and are flattest on the middle of the sides, and a permanent keel. By the small umbilicus *Harp. lunula* is distinguishable from most of the other *Harpoceras* of the middle and upper Jura, and by the want of three keels along the siphonal side, it is distinct from *Harp. Henrici, mendax, Delmontanum,* or others of lower or middle Oxfordian strata.

Geol. Surv. of India JURASSIC CEPHALOPODA FROM KACHH Pl. VIII



4. HARPOCERAS LAIRENSE, *Waagen, n. sp.* Pl. XIII, Figs. 3*a*, *b*, 4*a*, *b*.

This species has in general much resemblance to *H. hecticum*, Rein. It can, however, easily be distinguished by several characteristic features.

The general form of the adult specimen is flat, with compressed whorls, a tolerably wide umbilicus and keeled siphonal side. I have no specimen to examine the first stages of growth, but as it seems from the inner whorls of larger examples, they are smooth up to a diameter of four or five millimetres; then strong, slightly falciform ribs appear, which, however, are not continuous over the whole side of the whorl, but begin at the umbilicus and reach from there a little turned towards the front, until the middle of the side, where they finish in a somewhat elongated obtuse tubercle. There every one of them is replaced by two rather straight short ribs, which go from the middle of the side, a little turned backwards, to the siphonal part of the shell, where they terminate also in low tubercles.

This sculpture changes a little in larger specimens. There single, slightly falciform ribs go from the umbilical margins to near the siphonal side, swollen to an obtuse tubercle on the middle of the lateral part of the shell, but undivided. They terminate at the siphonal margin also with a low obtuse tubercle. Between those simple ribs are short straight ribs intercalated at the siphonal margin; they begin there with an obtuse tubercle and do not quite reach the middle of the side of the shell.

The umbilicus is always tolerably wide, about one-third or one-fourth of the diameter of the shell, and is surrounded in adult specimens by well defined perpendicular walls, which, however, do not exist in young specimens.

The siphonal side is, though not very sharp or rather obtuse, always distinctly keeled, on the air-chambers as well as on the body-chamber.

The lobes are very difficult to observe in the specimens I have got for examination, but are remarkable on account of the little development of the lobes in comparison with the enormous broad saddles. The siphonal lobe is very short and broad, with very short branches, very little dentated; external saddle also very broad and short, with a very small, nearly central secondary lobe; first lateral lobe very narrow, with few dentations and three narrow terminating branches; first lateral saddle broad, going a little higher up than the external, with a secondary lobe; second lateral lobe very narrow and small; there are one or two auxiliary lobes.

The dimensions of two specimens are—

	I.	II.
Diameter of the shell	38 mm.	37 mm.
„ of the umbilicus	11	10·5
Height of the aperture from the umbilical suture...	17	16
„ of the „ from the preceding whorl	12·5	12
Thickness of the „ on the tubercles	10·5	9·5
„ of the „ between the tubercles	9	?

In both specimens the last half turn is body-chamber, but the mouth of the shell is preserved in neither of them.

Remarks.—There are four specimens of this species among the materials I have for examination. Two of them were collected at Lair in light yellow marls with concretions, containing also *Pelt. athleta.* Another specimen comes also out of the *Athleta* bed north-east of Gudjinsir, and is preserved in a very hard gray marl nodule; the last specimen has been found north-west of Jikli in a hard yellow calcareous rock, very likely a little older than the *Athleta* bed. On the whole, we can therefore say that the species is of upper Callovian age.

Harp. Lairense is characteristic enough to distinguish it easily from the allied species. It unites the characters of *H. hecticum* and *punctatum* in one, having a row of tubercles in the middle of the sides and along the siphonal margins. At the same time it exhibits much straighter ribs than the species mentioned, and has much more compressed whorls than *H. punctatum.* Besides the peculiar arrangement of the ribs, which are not divided on the middle of the sides, but replaced there by two short ones, or the undivided ribs of larger specimens, between which short ones are intercalated on the outer margin, is a feature which never is again repeated in any other species of *Harpoceras.* By this character alone, besides the tubercles existing on the whorls, the species can be distinguished from *Harp. lunula*, *Rauracum*, or any other.

5. HARPOCERAS DYNASTES, *Waagen, n. sp.* Pl. XIII, Figs. 6*a*, *b*, 7*a*, *b*, 8*a*, *b*.

The dimensions of this species are very considerable in comparison with the other forms as yet described, and thus it is very conspicuous.

Young specimens resemble very much *H. lunula*, Ziet., but have a larger umbilicus and straighter ribs. The first stages of growth are, as in all the allied species, quite smooth, with depressed whorls and a slight, barely visible keel on the siphonal side. At a diameter of 10 mm. the ribs become visible. They are scarce, slightly falciform, divided into two branches on the middle of the sides. In a little larger specimen they are provided with small tubercles at their termination on the siphonal margin; but these soon disappear again, the section of the whorls becomes a little higher, the umbilicus a little smaller, and the sides of the shell are covered with slightly falciform ribs, which are yet present in very large specimens as broad not very prominent folds.

The umbilicus is wide in small specimens, gets a little narrower in specimens of middle size, and gets again wider in very large examples. It is surrounded by vertical walls, which, however, are rarely well defined. The siphonal side is always provided with an obtuse not very prominent keel, which becomes a little less distinct in very large specimens, and is there limited to the shell, not a trace being observable on the cast.

The lobes are short, not very complicated. The siphonal lobe is short, but not very broad, with a ramified branch on each side; external saddle not very broad, with a well developed secondary lobe nearly in the middle; first lateral lobe broad, a good deal longer than the siphonal, with many short thick branches, the latter little ramified; first lateral saddle narrow, going a little higher up than the external, much indentated; second lateral lobe narrow, shorter than the first, well ramified; second lateral saddle very narrow, going not quite so high up as the first. There are yet three well developed auxiliary lobes with narrow saddles between them.

The dimensions of two small specimens are—

	I.	II.
Diameter of the shell	27 mm.	41 mm.
" of the umbilicus	8	10
Height of the aperture from the umbilical suture	11	19
" of the " from the preceding whorl	9·5	?16
Thickness of the "	8	11

The largest fragment preserved in our Museum has for the last three measurements the following dimensions :—

Height of the aperture from the umbilical suture	62 mm.
" of the " from the preceding whorl	45
Thickness of the "	30

The whole fragment is composed of air-chambers.

Remarks.—Several specimens of *Harp. dynastes* have been collected in different localities. The largest and most characteristic specimens, mostly fragments, come from the *Athleta* bed, south-east of Nurrha, and are preserved in gray marl nodules, the shell itself being black calcspar; other specimens were found at Lair, also in the *Athleta* bed, and are preserved in a hard yellow calcareous marl. The third locality where the species occurs is the south-west side of Keera hill near Charee, in a dark shale, the fossils consisting of pyrites; the shales are just below the oolite bank with *Aspidoc. perarmatum.* From north of Gudjinsir come three fragments, which also belong to this species, but occupied there a situation a little below *Peltoc. athleta*; they are also turned into iron pyrites. Two small pyritic casts from Vanda I unite, though with some doubt, with this species.

The species is, I think, most nearly allied to *H. lunula,* Ziet., and the resemblance is striking, principally in large specimens. Yet one can always distinguish *H. dynastes* from Zieten's species by the much straighter ribs, which character is apparent in young as well as in adult specimens; besides that there are in young specimens little tubercles at the end of each rib along the siphonal margin which are wanting in *H. lunula. Harp. hecticum* is distinguished from our species also by much more curved ribs, whilst *H. Lairense* has rather straight ribs; they are, however, arranged quite differently.

6. HARPOCERAS RAURACUM, *C. Mayer*. Pl. XIII, Fig. 5*a*, *b*, *c*.

1837. *Ammonites Murchisoni*, (Sow.) Pusch: Polens Palæontologie, pl. 13, fig. 5, (non fig. 4, *non* Sow.).
1864. *Ammonites Rauracus*, Mayer: Journ. de Conch., Vol. xii, p. 376; Vol. xiii, pl. 7, fig. 4.
1866. *Ammonites Rauracus*, (Mayer) Oppel: Zone des Amm. transvers.; Benecke's geognost. pal. Beitr., II, p. 215.

The description given by Ch. Mayer is good, and the species can be easily identified from it. He says:—"Shell compressed, keeled, composed of six whorls, for two-thirds enveloping each other, rapidly increasing, compressed. Ribs thick, flexuose, rarely bifurcate; interrupted in the middle of the sides by a kind of canal strongly directed towards the front in the part lying between this canal and the umbilical suture, turned backwards in the outer part, and becoming broader towards the siphonal side, where they gradually disappear. The lateral lobes are rather long and are four in number."

Young specimens are smooth, as in all the other allied species, but in this instance they have whorls not so strongly depressed as is common, but are rather compressed with peculiarly flattened sides. At a diameter of the shell of about 10-15 mm. faint, not very numerous, curved ribs appear near the siphonal side, which soon begin to correspond with little folds at the umbilical margin. The perfect sculpture, as it is described by Mayer, is mostly developed only at a diameter of about 30 to 35 mm., and the shell is then highly characteristic in its appearance.

The width of the umbilicus is somewhat variable; it is sometimes a little less, sometimes a little more, than one-third of the diameter of the shell. In small specimens the umbilicus is surrounded by perpendicular walls, which are well defined from the sides of the whorl, forming an umbilical edge; this latter, however, becomes often more or less obsolete in larger specimens. The siphonal side is always provided with a well marked obtuse keel, on each side of which a fainter ridge goes along; thus the siphonal side appears trimarginate.

The lobes are not sufficiently preserved to admit of an accurate description.

The dimensions of the only specimen I have for examination are—

Diameter of the shell	33 mm.
" of the umbilicus	12
Height of the aperture from the umbilical suture	13·5
" of the " from the preceding whorl	11·5
Thickness of the "	10

Remarks.—The only specimen of this species has been collected in the oolites with *Asp. perarmatum* north-west of Soorka.

Ch. Mayer, very reasonably, compares his species with *H. Delmontanum*, Opp., which is in fact the nearest allied species, but is distinguishable by narrower siphonal side, stronger ribs, and smaller umbilicus. Other species, which also resemble *H. rauracum*, like *H. lunula* or *H. dynastes*, differ from Mayer's species by the want of three ridges along the siphonal side and the different ornamentation of the sides of the shell.

(*b.*) *Group of* HARPOCERAS IGNOBILE, *Sow.*

1. HARPOCERAS IGNOBILE: *J. de C. Sow.* Pl. XII, Figs. 1, 1*a*, 2, 2*a*, 2*b*.

1840. ***Ammonites ignobilis***, J. de C., Sow.: Transact. Geol. Soc., Lond., II Ser., Vol. v, pl. 23, fig. 11 and expl.
1850. ***Ammonites lunula*** (Ziet.) Orbigny: (pars): Prodrome, I, p. 329, No. 22. (Cited from Kachh).

It was a very good and highly characteristic species, which Sowerby designated under the above mentioned name, and the figures and descriptions which I am going to give will confirm this opinion.

I have no example to observe the first stage of growth of this species; the smallest specimen I have has 28 mm. in diameter. At that age, the shell has a tolerably narrow umbilicus, the sides of the whorls are flat, and covered with readily distinguishable falciform ribs, which bear on the siphonal margin a fine rounded tubercle. The siphonal side shows a strong keel, and the whole shell has a great resemblance to certain varieties of *Harp. hecticum*. As the species grows larger the remarkable straightness of the outer part of the ribs, which Sowerby's figure so well represents, appears more defined. This sculpture remains till a diameter of 50 mm. Exceeding this, the sculpture becomes gradually weaker, the points on the siphonal margin disappear, also the inner part of the ribs, and at the same time the sides of the whorls become more rounded. This is the sculpture of the body-chamber, which is about half a whorl in length. The siphonal side is there more rounded, but a trace of the keel remains up to the mouth. The mouth itself is not preserved on any of the examples. The umbilicus is rather narrow, surrounded by perpendicular walls, which form a distinct edge in joining the sides of the whorls.

The sutures are very much like those described before on *Harp. hecticum*, but they appear in their general form a little longer and more slender. The second lateral lobe is asymmetrical as in the species just mentioned.

The dimensions are—

	I.	II.
Diameter of the shell	50 mm.	88 mm.
„ of the umbilicus	10	20
Height of the last whorl from the umbilical suture	26	37
„ of the „ from the siphonal side of the preceding whorl ...	20	29
Thickness of the „	15	23

Remarks.—The specimens belonging to this species, lying before me, are nine, five of them coming from Keera hill near Charee. None of them shows traces of golden oolite; all are preserved in a yellowish gray, very hard marly rock, out of which no true *Steph. macrocephalum* is preserved in the Museum. They belong to a layer, representing the Upper Kallovian of Europe, more especially to the equivalents of the zone of *Perisph. anceps*, or a little lower. Another specimen has been collected on north-west of Jara in the same horizon, preserved in an iron nodule; two are from Vanda, coming also out of the same horizon, preserved in grayish-yellow marl nodules; the last specimen has been found north-west of Jikli, loose on the ground. It also is preserved in a yellow marl nodule.

Harpoceras ignobile shows rather strong alliances to *Harp. hecticum*, but much less to *H. lunula*, with which Orbigny wishes to identify this species. From both species the Indian form is easily distinguished by the straightness of the ribs, which gives these shells a very strange aspect. Besides this the differences from *Harp. hecticum* lie in a smaller umbilicus: from *Harp. lunula* in stronger and pointed ribs, much less in number.

2. HARPOCERAS CRASSEFALCATUM, *Waagen, n. sp.* Pl. XII, Figs. 6, 6*a*, 7.

Under this name I will describe a beautiful species of Ammonite. The common aspect is very much like *Harp. hecticum*, but a little careful examination will easily distinguish both species. I have no example to observe the youngest stages of growth. At a diameter of the shell of 15 mm. the whorls are about as broad as high, the ribs are very thick and rounded, only a little curved, and mostly on the outer part of the whorl divided into two branches; they finish on the siphonal margin in high rounded tubercles. When the individual grows larger, the height of the whorls by far exceeds the breadth, but the ornamentation undergoes only slight changes. The siphonal side is obtuse, with a distinct, but not very high keel. At a diameter of 50 mm. I count on the outer margin twenty ribs and tubercles, on the inner margin eleven ribs. At the place where the ribs divide themselves into two, they are a little thickened, forming a kind of tubercle. The largest example I know has 66 mm. in diameter, but the form is in all points the same as in the smaller specimens. The umbilicus is rather narrow, surrounded by perpendicular walls, which do not form a very distinct umbilical edge in joining the sides of the whorls.

The lobes are very like those of *Harp. ignobile*, Sow., but not sufficiently preserved to draw them.

The dimensions of the two examples existing are—

	I.	II.
Diameter of the shell	50 mm.	66 mm.
„ of the umbilicus	11	15
Height of the last whorl from the umbilical suture	25	30
„ of the „ from the siphonal side of the preceding whorl ...	18	24
Thickness of the last whorl	19	22

Remarks.—Though *Harp. crassefalcatum* shows great affinity to the species before described, I thought it proper to give it a separate name, because the form of the shell is in certain characteristic points constantly different.

Harp. crassefalcatum is always much thicker and much more strongly ornamented than *Harp. ignobile*, and instead of losing its ornamentation in larger stages of growth, on the contrary, this increases in strength. From *Harp. hecticum* my species differs by the much stronger, straighter, and less numerous, ribs and tubercles.

Both examples I have for description are out of the same yellowish-gray hard marl rock, which contained the specimens of *Harp. ignobile.* From Europe this form is not yet known.

3. HARPOCERAS TRILINEATUM, *Waagen, n. sp.* Pl. XIII, Fig. 2*a*, *b*.

This species exhibits very distinctly the character of the group,—the very peculiar straightness of the ribs. It is, however, not difficult to distinguish from both species before described.

The shell is not very flat, disciform, with a wide umbilicus and an obtuse, keeled siphonal side. Young specimens up to a diameter of 5 mm. are entirely smooth, with broad depressed whorls, then thick slightly falciform ribs appear gradually, and give to the shell somewhat the appearance of *H. punctatum*, Stahl., but the ribs are always much straighter. The ribs begin at the umbilical suture as thick rounded prominences, and are divided into two branches, forming an elongated tubercle at the point of division, already in the lower third of the height of the whorl. The secondary ribs start from the point of division in a straight direction to the siphonal margin and terminate there without forming a distinct tubercle. The whole rib shows only one bend at the spot where the bifurcation takes place, where a flat angle directed with its apex towards the front is formed.

The umbilicus is flat in not quite adult specimens, and not surrounded by proper walls; in larger specimens, however, an umbilical wall is formed, which is not limited by an umbilical edge. A peculiarity is, that the points of partition of the ribs are yet visible in the umbilicus, which gives the whorl a remarkable appearance.

The siphonal side is rather broadly obtuse with a low broad keel in the middle, and two lower, narrow ridges on both sides of it. Both keel and ridges are visible also on casts.

The lobes are not very well preserved in the specimens I have for examination. The siphonal lobe is short and not very broad, the external saddle very broad and short, with a small secondary lobe not quite in the middle; the first lateral lobe is a good deal longer than the siphonal terminating with three nearly symmetrical branches; first lateral saddle going rather high up, tolerably broad, with two small secondary lobes; second lateral lobes very narrow, much shorter than the first; one larger and one very small auxiliary lobe.

The dimensions of two specimens of this species are—

	I.	II.
Diameter of the shell	44 mm.	49 mm.
" of the umbilicus	14·5	16
Height of the aperture from the umbilical suture	19	22
" of the " from the preceding whorl	14	16·5
Thickness of the "	14	17

Remarks.—Two specimens of this species were collected in Kachh, one in a yellow marl rock together with the two preceding species of the same group at the south-west side of Keera hill near Charee; the other also in a yellow marl rock together with *Harpoceras lunula* at Vanda.

H. trilineatum is principally nearly allied to *H. crassefalcatum*, W., but is distinguishable easily from it by much finer and much more numerous ribs, which do not terminate on the siphonal margin with a developed tubercle. From *H. ignobile* our species differs by more depressed whorls, stronger ribs, and wider umbilicus. The trimarginate siphonal side is also a feature of *H. trilineatum*, not repeated in the two species just alluded to. Other trimarginate species of the genus *Harpoceras*, like *H. rauracum*, *scabridum*, or others, have all much more curved ribs, and are easily distinguishable from the species here described.

(c.) ISOLATED SPECIES.

HARPOCERAS KOBELLI, *Oppel*. Pl. XIII, Figs. 11*a*, *b*, 12*a*, *b*, 13*a*, *b*.

1863. *Ammonites Kobelli*, Oppel.: Palæontolog. Mittheilung., p. 273, pl. 76, fig. 1*a*—*c*, fig. 2*a*, *b*.

The specimens of this species are, perhaps, the most interesting among the whole series collected in Cutch, as they not only tend largely towards a right understanding and classification of other jurassic rocks in India in which *Harp. Kobelli* occurs, but will also partly be able to solve the controversy which arose about the Liassic Ammonites which were said to have been fonnd in Indian strata.

The species is very variable as far as ornamentation is concerned, smooth, or with scarce thick falciform ribs. Young specimens up to a diameter of about 20 to 25 mm. are always entirely smooth, if the shell is preserved; casts, however, exhibit a shallow spiral canal running along the middle of the sides of the whorls. The shell itself is very much worn in the specimens I have for description, so that one cannot observe the fine striæ of growth which are drawn in Oppel's figures. The umbilicus is wide, the whorls compressed, but with rounded sides, the siphonal part of the shell rounded without a trace of a keel. The keel appears only at 25 mm. diameter, when at the same time for the most part the ornamentation of the shell also appears, but in specimens which never are provided with any ribs, a keel is formed at about 30 mm. diameter.

In examples larger than those as yet described here, the sides of specimens provided with the shell bear a deep canal below their middle towards the umbilicus, which is fenced at the umbilical side by a rather sharp narrow ridge. On the part of the shell between the canal and the siphonal side strong broad rounded ribs are visible, which begin gradually as the specimens grow larger than 25 mm. in diameter, and increase in strength in larger specimens. They rise near the canal as thin ribs, directed nearly horizontally backwards, turn then in a strong curve, gaining much in strength towards the siphonal side, and disappear again before reaching the latter part of the shell with a curve towards the front. That division of the sides of the whorls which lies between the canal and the umbilicus is entirely smooth, and slopes gradually towards the umbilical suture; only in larger specimens an obtuse umbilical ridge is observable. The line along which the umbilical suture joins the preceding whorl runs always along and a little outside the canal of the latter.

The variability I alluded to is not only, however, apparent in specimens of different age, but specimens of equal dimensions are often entirely different in aspect, as will be seen from the figures given in Pl. XIII. The ribs described before frequently never appear, the shell remains entirely smooth, only provided with the canal on the lateral part of the shell. Ribbed examples differ from each other by the number and sharpness of the ribs, which often appear exactly as in the specimens figured by Oppel, but often are also more scarce and broadly rounded, or more numerous.

The lobes in the specimens I have for examination are commonly not so long as drawn by Oppel. The siphonal lobe is rather short and broad, little ramified, only with two short branches; external saddle short and broad, with a small secondary lobe in the middle; first lateral lobe much longer than the siphonal, but rather broad, with three short branches at the end; first lateral saddle going much higher up than the external, not very broad, with two indistinct secondary lobes; second lateral lobe about the shape of the first one, but much shorter; there are two auxiliary lobes above the umbilical suture.

The dimensions of three specimens are the following—

		I.	II.	III.
Diameter	of the shell	42 mm.	41 mm.	36 mm.
„	of the umbilicus	15	12	12
Height	of the aperture from the umbilical suture	16	17	13
„	of the „ from the preceding whorl	14	15	11
Thickness	of the „	10	9·5	8

There have been found in Kachh no such large specimens as those figured by Oppel from Niti.

Remarks.—The species is represented by a fair number of specimens in our Museum, all collected by Dr. Stoliczka. By far the largest part of them has been found south-west of Nurrha, in a nodular sandy limestone with many fragments of plants and mica in the middle region of the Katrol group. Another specimen comes from north-east of Gudjinsir out of the same beds, but preserved in a red ferruginous sandstone nodule.

There is, I think, no doubt that the Kachh specimens are identical with the species described by Oppel, and, though large specimens are wanting among the materials from Kachh, a comparison of Oppel's smaller figure and the figures given on Pl. XIII will show easily that they all belong to one and the same species. Also Oppel's specimen has on the inner whorls the canal or furrow only visible on the cast, and the keel seems to appear just before the end of the last whorl. Only the lobes show a certain slight difference, as they appear to be not quite so long and narrow in the Kachh specimens as in those from Niti. The differences of *H. Kobelli* from *H. bifrons* are easy to recognize if once stated. They consist in the want of furrows on both sides of the keel on the siphonal part of the shell, and in the narrow ridge by which the furrows on the sides of the whorls is limited towards the umbilicus. No other species excepting *H. bifrons* can be compared with the Indian form.

It is one of the anomalies experienced in the investigation of formations in very distant countries that often certain types of form which one is accustomed to find only in certain limited beds in one country, in another appear on quite different horizons, thus rendering it often extremely difficult to identify those beds as of the age to which they in reality belong. Such an instance we have in *H. Kobelli*, whose extreme resemblance to *H. bifrons* of the Lias of Europe led the scientific world to believe that it must have its position also in Liassic beds. That this is not the case the specimens from Kachh show, which were found on a horizon corresponding to about the middle of the Kimmeridge group.

This occurrence of the species in the Kachh jurassic beds is of importance, as it serves to furnish at last the decisive proof against one of the grossest accusations ever pronounced against a man of so high a scientific standing as Oppel had attained. The news of the controversy about the origin of the specimens which served as originals for the drawings of the Rev. Mr. Everest, which had arisen in Calcutta, had just reached Europe, as the second part of Oppel's "Mittheilungen" was published. Some undefined talk about it must have been related also to Mons. Amie Boué, who was not at all connected with the scientific questions then raised, in fact was an entire stranger to the description and distinction of Jurassic Ammonite species, as well as to the questions about their geological horizons or their geographical distribution, but who was yet induced to make in public at the session of the Imperial Academy of Sciences of Vienna some very serious remarks about Oppel's Himalayan Ammonites. After having stated that those are very much in the wrong who despise Palæontology, or believe it to be an entirely distinct science from Geology, he proceeds: "That not every man has got the taste, talents or means for palæontological enquiries is natural, but then not every one is permitted to give his opinion about such points. An unnecessary and even ridiculous increase of the number of species can happen such as that brought forward by Oppel, caused by the change of boxes from and for Calcutta." It is clear from these words that Mr. Boué never can have read either the memoirs in the Journal of the Asiatic Society of Bengal or Oppel's book, or else he would not have styled the latter "Beitraege" whilst the title is "Mittheilungen." That no such thing existed as a change of boxes was already stated by Benecke, who also pointed out that Boué could not have given the declaration quoted above of his own accord. Some benevolent friend, who had not courage to come forward himself, and who did not hesitate to concoct a little story from half digested rumours, must have instructed Mons. Boué, who took for granted all that he was told. The sad part of the whole, however, is, that the intense excitement, caused by Boué's article, seemed to accelerate in Oppel the outbreak of a nervous fever, of which a few days before his youngest child had died, and which had cast already its forebodings on Oppel's youthful life.

It is a debt due to Oppel's memory by the scientific world to unravel every thing connected with Oppel's Himalayan Ammonites, and I feel happy that it has fallen to my lot to be able to redescribe for the first time that species from the Indian deposits, which was likely to raise the greatest suspicion, and so to dispel any doubts which might still have existed about the Indian origin of Oppel's specimens.

GENUS *PELTOCERAS*, WAAGEN.

A short diagnosis of this genus I have given already in the Records of our Survey, 1871, p. 91, but the exact reasons which caused me to separate the forms placed under the genus *Peltoceras* from *Aspidoceras*, Zittel, I have yet to explain.

The genus *Aspidoceras* was proposed in 1868 by Zittel in his "Cephalopoden der Stramberger Schichten," but only in 1870 he gave a strict description of it and defined it to a certain number of species, which ought to correspond nearly with the group of the *Armati* as it is accepted by Quenstedt in his "Cephalopoden," but not with the *Armati* of v. Buch, which is something quite different. There is no doubt that the *Armati* of Quenstedt form a well-defined and well-characterised group, but Quenstedt includes therein some species which are distinctly excluded by Zittel from his genus; those are "*Ammonites athleta, Arduennensis, annularis*, etc."

It is very difficult to decide on the position of those species just mentioned, though their relation to the other groups of Ammonites is very clear. There is no doubt that they are very nearly allied to the *Planulati* or the genus *Perisphinctes*, though they are even in their young stages of growth easily distinguishable by their general appearance. But not less are they allied with the genus *Aspidoceras*, even so much that larger examples, (I have figured one of an allied species on pl. 15, fig. 1), show almost no differences from forms really belonging to the genus just quoted; Quenstedt had therefore good reason to unite those species with his *Armati*, and I should rather prefer to adopt his views on this point than the views of Prof. Zittel, who puts them in the genus *Perisphinctes*. Certainly he had some very good reasons for doing so, such as are the existence of contractions of the shell, though they are only very rarely to be observed, and the eared mouth of most of the species in younger stages of growth, but, on the other hand, the sutures are quite different from those commonly existing in the *Perisphinctes*, and nearly all the species, except a few of the group of *P. annulare*, arrive, after having attained a certain size, at the general form of a certain group of *Aspidoceras*. Therefore, I think, if one would not create a separate genus for those forms, it would be more convenient to take them under the designation of *Aspidoceras*.

But the genus *Aspidoceras* thus defined would have to be divided into two large sections, each of them having about the importance of a genus, and it seems to me better to make the division permanent, and to create a new generic designation for the species which Zittel distinctly excluded from his genus and the allied forms, than to extend the limits of the genus *Aspidoceras*, so far that the species cannot be easily comprised under one simple diagnosis. I proposed, therefore, for the species allied to *Amm. annularis*, *Constanti*, and some others a new generic designation, *Peltoceras*.

The species belonging to this genus are mostly patelliform, with very large umbilicus, whorls with strong straight ribs, which are mostly provided with two or three rows of spines in adult specimens; siphonal side more or less flattened or even excavated, the ribs passing over it or disappearing before they reach it; sutures with very much enlarged predominant first lateral lobe, very broad external saddle, and second lateral lobe very little developed, or entirely wanting. Most essential for the generic determination of the shells I place under the name of *Peltoceras* is the form of the earlier stages of growth, which is characteristic to a high degree, and varies but very little in most of the species. The strong, sharp, mostly dichotome, but sometimes also undivided, ribs which cover the inner whorls of those Ammonites cannot be easily mistaken, and serve well to recognise the genus, even in specimens where other characteristics are not observable. The whorls are always very little embracing, and the transversal section of the latter somewhat rectangular.

The general typical form of the shell is modified in different species in several directions, such as that the spines are entirely wanting, or the ribs nearly entirely replaced by corresponding spines, but the general type of the genus can nevertheless even in such forms, be easily recognised.

There is no doubt that, if we follow up the different developmental series of the genus to their root, we are carried to some form of *Perisphinctes* wherefrom the genus takes its origin, but to indicate the species which forms the connecting link between the two genera is absolutely impossible. The near affinity between *Peltoceras* and *Perisphinctes* is not only shown by the general appearance of the young specimens of species of the former genus, but also by the occurrence of faint contractions of the shell in one or the other of the *Peltoceras*. There are, however, yet other genera which take their rise from *Perisphinctes*, as *Aspidoceras* and *Simoceras*, and which are very nearly allied to our genus; in fact, so much so that I formerly thought it necessary to unite a part of the forms generally comprised under the name of *Aspidoceras*, the group of *Asp. perarmatum* and allied species, with *Peltoceras*.

PLATE V.

Fig. ... 1. **Phylloceras Mediterraneum**, *Neumayr*, p. 34; specimen with preserved shell, more than half of the last whorl belonging to the body-chamber; from the *Macrocephalus shales* north-west of *Soorka;* 1*a*, side-view; 1*b*, front-view.

Fig. ... 2. **Phylloceras** *cf.* **Kunthi**, *Neumayr*, p. 25; specimen, with partly preserved shell, from the *Athleta beds* of *Leir;* 2*a*, side-view; 2*b*, front-view; 2*c*, lobes.

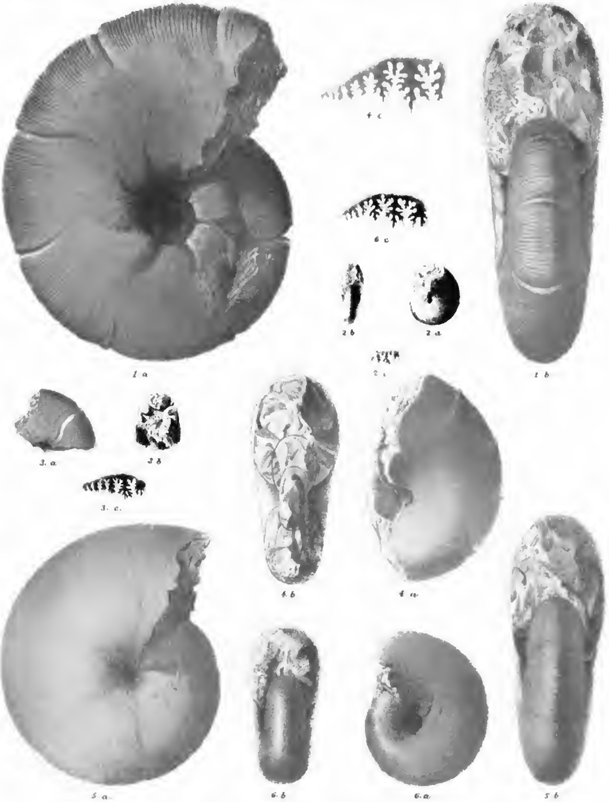
Fig. ... 3. **Phylloceras Benacense**, *Catullo*, p. 33; fragment of a specimen from the *Katrol group* of east of *Rodur;* 3*a*, side-view; 3*b*, front-view; 3*c*, lobes.

Fig. ... 4. **Phylloceras vicarium**, *Waagen*, n. sp., p. 26; fragmentary specimen from the *Macrocephalus beds* north-west of *Jumara;* 4*a*, side-view; 4*b*, front-view; 4*c*, lobes.

Fig. ... 5. **Phylloceras Lodaiense**, *Waagen*, n. sp., p. 32; specimen with preserved shell from the *Dhosa-oolite*, west of *Jumara;* 5*a*, side-view; 5*b*, front-view.

Fig. ... 6. **Phylloceras Jaraense**, *Waagen*, n. sp., p. 28; specimen of a cast from the *Dhosa-oolite*, north-west of *Jara;* 6*a*, side-view; 6*b*, front-view; 6*c*, lobes.

Geol. Surv. of India. JURASSIC CEPHALOPODA FROM KACHH Pl. V.



Lith. and print. at the Geol. Survey's Office Calcutta.

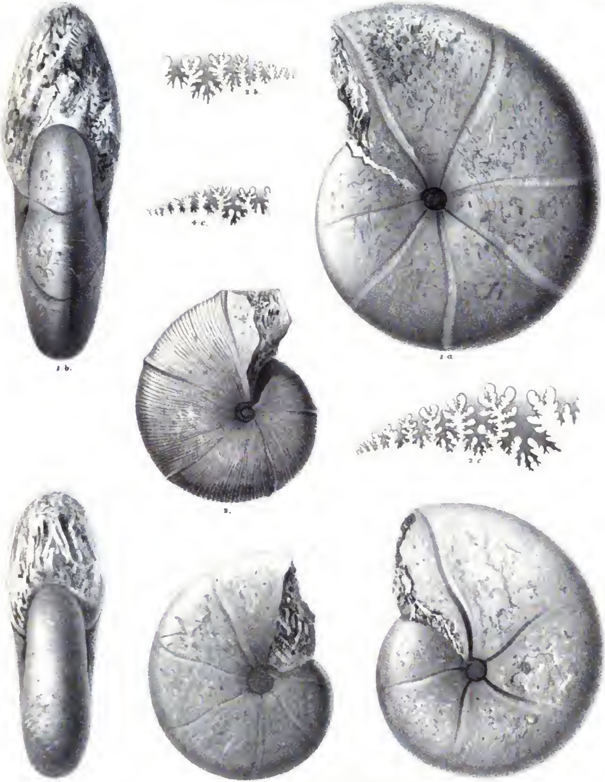
PLATE VI.

Fig. ... 1. **Phylloceras disputabile**, *Zittel*, p. 31; specimen without body-chamber and without preserved shell, showing seven furrows; from the *Macrocephalus beds* (golden oolite) of *Keera hill* near *Charee;* 1*a*, side-view; 1*b*, front-view.

Fig. ... 2. **Phylloceras disputabile**, *Zittel*, p. 31; 2*a*, inner whorls of a large specimen without preserved shell, showing six furrows, side-view; 2*b*, lobes from the inner whorls; 2*c*, lobes from the outer whorls of the same specimen; from the same bed and locality as fig. 1.

Fig. ... 3. **Phylloceras disputabile**, *Zittel*, p. 31; inner whorls of a large specimen with five furrows, with preserved shell, side-view; from the same beds and locality as fig. 1.

Fig. ... 4. **Phylloceras Lodaiense**, *Waagen*, n. sp., p. 32; specimen without preserved shell from the *Dhosa-oolite* of *Lodai;* 4*a*, side-view; 4*b*, front-view; 4*c*, lobes.



Lith and print at the Geol: Survey's Office

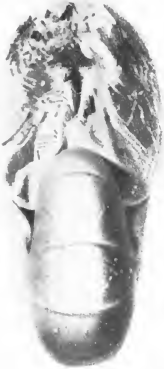
PLATE VII.

Fig. ... 1. Phylloceras Feddeni, *Waagen*, n. sp., p. 27; specimen without body-chamber out of *upper Callovian* beds on the road from *Jooria* to *Dhosa;* 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.

Fig. ... 2. Phylloceras ptychoicum, *Quenstedt*, p. 30; specimen without body-chamber out of the *Katrol group* of the *Katrol range;* 2*a*, side-view; 2*b*, front-view; 2*c*, lobes.

Fig. ... 3. Phylloceras Mediterraneum, *Neumayr*, p. 34; fragment of a small specimen with preserved shell from *upper Callovian* beds of the *valley west of Soorka hill;* 3*a*, side-view; 3*b*, section; 3*c*, lobes.

Fig. ... 4. Haploceras *cf.* tomephorum, *Zittel*, p. 43; specimen without body-chamber from the upper beds of the *Katrol group*, south of *Bújuri;* 4*a*, side-view; 4*b*, front-view.



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4. a.

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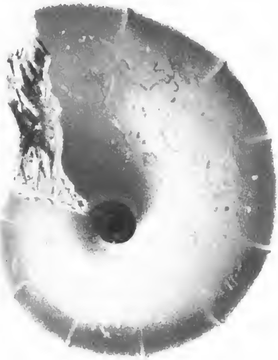

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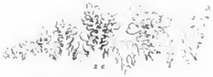

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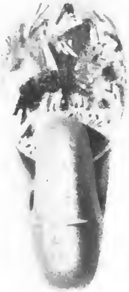

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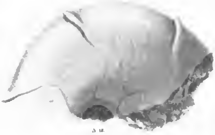

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3. c.

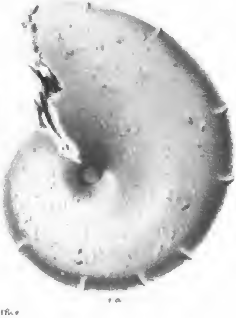

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PLATE VIII.

Fig. ... 1. **Lytoceras rex**, *Waagen*, n. sp., p. 36; specimen in 0·5 natural size, from the *Katrol group* near *Charee;* 1*a*, side-view; 1*b*, transversal section of one of the inner whorls.

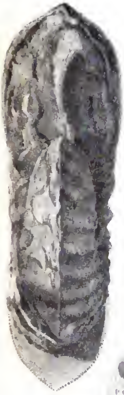
Fig. ... 2. **Lytoceras Adeloides**, *Kudernatsch*, p. 37; lobes of a fragment from the *Macrocephalus beds* (golden oolite) of *Keera hill* near *Charee.*

PLATE IX.

Fig. ... 1. **Amaltheus Schaumburgi**, *Waagen*, n. sp., p. 41; specimen with preserved body-chamber, without shell, from the *Athleta beds* of *Gudjinsir;* 1*a*, side-view; 1*b*, front-view; 1*c*, back-view.

Fig. ... 2. **Amaltheus pustulatus**, *Reinecke*, sp., p. 40; specimen with preserved shell, without body-chamber, from the *Athleta beds* far off north-east of *Gudjinsir;* 2*a*, side-view; 2*b*, front-view; 2*c*, back-view.

Fig. ... 3. **Phylloceras insulare**, *Waagen*, n. sp., p. 29; fragmentary specimen, with partly preserved shell, from *Gangta bét;* 3*a*, side-view; 3*b*, front-view; 3*c*, lobes.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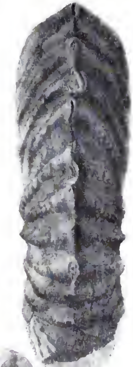
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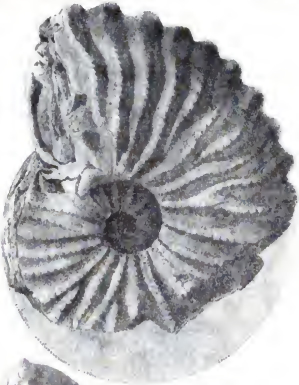
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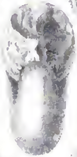
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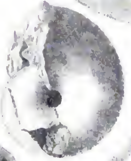
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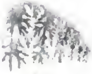
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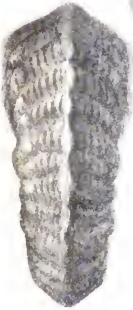
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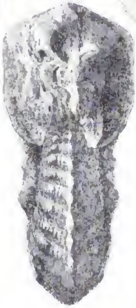
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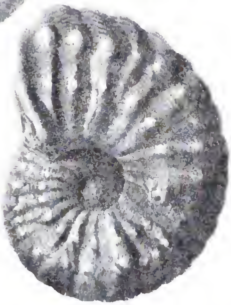
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PLATE X.

Fig. ... 1. OPPELIA SUBCOSTARIA, *Oppel*, p. 48; specimen without body-chamber from the *Macrocephalus beds* (golden oolite) of *Keera hill* near *Charee;* 1, side-view; 1*a*, front-view.

Fig. ... 2. OPPELIA SUBCOSTARIA, *Oppel*, p. 48; inner whorls of a larger specimen from the *golden oolite* of *Keera hill* near *Charee;* 2, side-view; 2*a*, front-view.

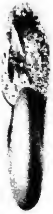
Fig. ... 3. OPPELIA (OECOTRAUSTES) SERRIGERA, *Waagen*, p. 57; compressed specimen out of calcareous shales of the *Puchum group*, south of *Nurrha;* side-view.

Fig. ... 4. OPPELIA KACHHENSIS, *Waagen*, n. sp., p. 55; specimen without body-chamber from the *Katrol group* of the *Katrol range;* 4, side-view; 4*a*, front-view; 4*c*, lobes.

Fig. ... 5. OPPELIA PLICODISCUS, *Waagen*, n. sp., p. 56; small specimen, composed of air-chambers, from the *Katrol group* south of *Madapoor;* 5, side-view; 5*a*, front-view.

Fig. ... 6. OPPELIA TRACHYNOTA, *Oppel*, p. 54; small specimen, composed of air-chambers, from the *Katrol group* of the *Joora hills;* 6, side-view; 6*a*, front-view.

Fig. ... 7. OPPELIA *cf.* GLABELLA, *Leckenby*, p. 49; body-chamber and last two air-chambers of a specimen from the *Athleta beds* of *Keera hill* near *Charee;* 7, side-view; 7*a*, section.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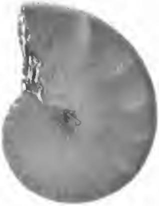
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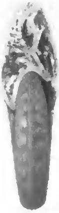
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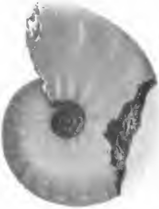
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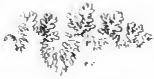

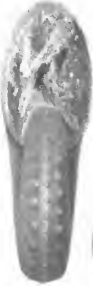
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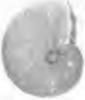

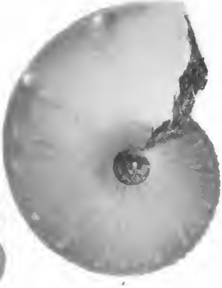
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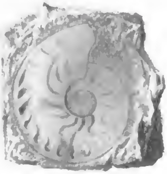
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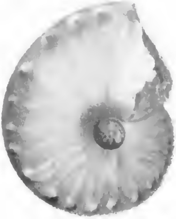
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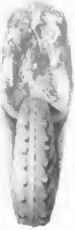
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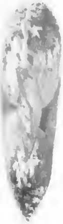
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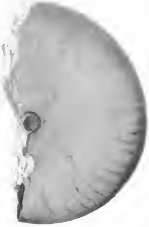
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PLATE XI.

Fig. ... 1. Oppelia bicostata, *Sthl.*, p. 52; specimen with preserved body-chamber from the *Athleta beds* south-west of *Barasore;* 1*a*, side-view; 1*b*, front-view; 1*c*, back-view; 1*d*, lobes.

Fig. ... 2. Oppelia Nurrhaensis, *Waagen*, n. sp., p. 51; specimen with preserved body-chamber out of the beds with *Perisph. anceps*, from north-west of *Jumara;* 2*a*, side-view; 2*b*, front-view.

Fig. ... 3. Oppelia plana, *Waagen*, n. sp., p. 56; specimen with preserved body-chamber from the *Katrol group*, south-west of *Nurrha;* 3*a*, side-view; 3*b*, front-view.

Fig. ... 4. Haploceras propinquum, *Waagen*, n. sp., p. 45; specimen without body-chamber from the lowest beds of the *Katrol group*, south side of *Keera hill*, near *Charee;* 4*a*, side-view; 4*b*, front-view.

Fig. ... 5. Oppelia Orientalis, *Orbigny*, p. 58; specimen with preserved body-chamber from the beds with *Perisph. anceps* of north-west of *Jara;* 5*a*, side-view; 5*b*, front-view; 5*c*, back-view.

Fig. ... 6. Oppelia Orientalis, *Orbigny*, p. 58; fragment of an inner whorl from Keera hill near Charee; side-view.

Fig. ... 7. Oppelia, *species indeterminata;* specimen from the *Athleta beds* of *Barasore*, not mentioned in the text, figured only to show the occurrence of another species of *Oppelia* in the Athleta beds.

Fig. ... 8. Aptychus *of* Oppelia, p. 59; specimen out of the *Katrol group* of an unknown locality in *Kachh;* 8*a*, outer-view; 8*b*, inner-view; 8*c*, front-view.

Fig. ... 9. Haploceras deplanatum, *Waagen*, n. sp., p. 44; specimen without body-chamber from the *Katrol group* of the *Charvar range*, south of *Bhooj;* 9*a*, side-view; 9*b*, front-view; 9*c*, lobes.

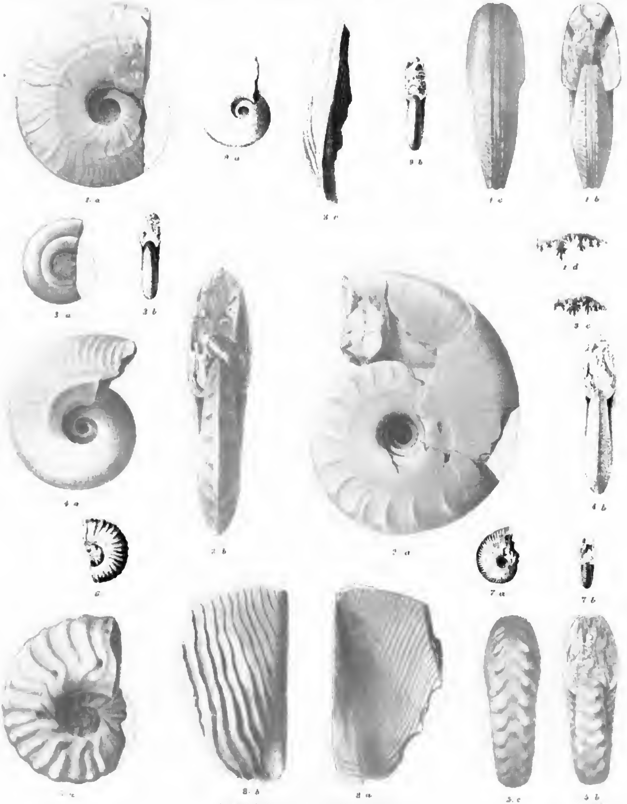

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PLATE XII.

Fig. ... 1. Harpoceras ignobile, *Sowerby*, p. 69; specimen with preserved body-chamber from the beds with *Perisph. anceps*, from *Keera hill;* 1, side-view; 1*a*, front-view.

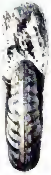
Fig. ... 2. Harpoceras ignobile, *Sowerby*, p. 69; specimen without body-chamber from the same bed and locality as fig. 1; 2, side-view; 2*a*, front-view; 2*b*, lobes.

Figs. 3—5. Harpoceras hecticum, *Reinecke*, p. 61; large specimen without body-chamber from the *golden oolite* of *Keera hill;* 3, middle whorl side-view; 3*a*, back-view; 3*b*, section; 4, inner whorl side-view; 4*a*, back-view; 4*b*, section; 5, lobes of the outer whorl from the siphonal to the antisiphonal lobe.

Fig. ... 6. Harpoceras crassefalcatum, *Waagen*, n. sp., p. 70; specimen without body-chamber from the beds with *Perisph. anceps*, from *Keera hill;* 6, side-view; 6*a*, front-view.

Fig. ... 7. Harpoceras crassefalcatum, *Waagen*, n. sp., p. 70; smaller specimen from the same beds and locality as fig. 6; side-view.

Fig. ... 8. Oppelia Orientalis, *Orbigny*, p. 58; fragment of the inner whorls from *Keera hill;* 8, side-view; 8*a*, back-view; 8*b*, section.



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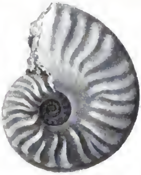

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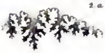

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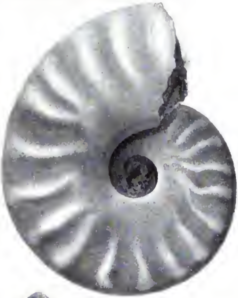

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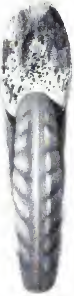

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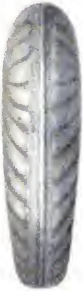

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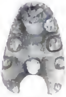

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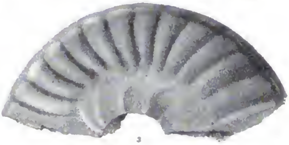

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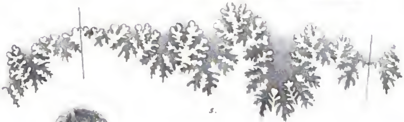

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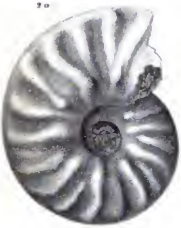

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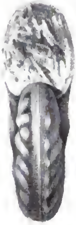

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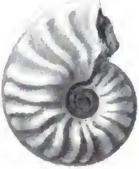

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PLATE XIII.

Fig. ... 1. Harpoceras lunula, *Zieten*, p. 63; specimen without body-chamber and partly preserved shell from the *beds with Perisph. anceps* of *Vanda;* 1*a*, side-view; 1*b*, front-view.

Fig. ... 2. Harpoceras trilineatum, *Waagen*, n. sp., p. 71; specimen with partly preserved body-chamber from beds a little *below the Dhosa-oolite;* (beds with *Perisph. anceps?*) south-west side of *Keera hill* near *Charee;* 2*a*, side-view; 2*b*, front-view.

Fig. ... 3. Harpoceras Lairense, *Waagen*, n. sp., p. 65; specimen with partly preserved shell, the last half of the last whorl belonging to the body-chamber; from the *Athleta bed* of *Lair;* 3*a*, side-view; 3*b*, front-view.

Fig. ... 4. Harpoceras Lairense, *Waagen*, n. sp., p. 65; fragment of the body-chamber of a small specimen from the *Athleta bed* north-east of *Gudjinsir;* 4*a*, side-view; 4*b*, section.

Fig. ... 5. Harpoceras rauracum, *C. Mayer*, p. 68; specimen without body-chamber from the *Dhosa-oolite*, north-west of *Soorka;* 5*a*, side-view; 5*b*, front-view; 5*c*, back-view.

Fig. ... 6. Harpoceras dynastes, *Waagen*, n. sp., p. 66; fragment of a large specimen with preserved shell from the *Athleta bed* south-east of *Nurrha;* 6*a*, side-view; 6*b*, section.

Fig. ... 7. Harpoceras dynastes, *Waagen*, n. sp., p. 66; fragment of a small specimen with preserved shell from the *Athleta beds* south-east of *Nurrha;* 7*a*, side-view; 7*b*, section.

Fig. ... 8. Harpoceras dynastes, *Waagen*, n. sp., p. 66; pyritic cast of a small specimen from the *Athleta beds* of *Keera hill;* 8*a*, side-view; 8*b*, front-view.

Fig. ... 9. Harpoceras punctatum, *Stahl.*, p. 63; specimen without body-chamber from the beds with *Perisph. anceps* of *Vanda;* 9*a*, side-view; 9*b*, front-view.

Fig. ... 10. Harpoceras punctatum, *Stahl.*, p. 63; specimen found loose on the ground near *Barasore*, side-view.

Fig. ... 11. Harpoceras Kobelli, *Oppel*, Typus, p. 72; specimen with partly preserved body-chamber from the *Katrol group*, south-west of *Nurrha;* 11*a*, side-view; 11*b*, front-view.

Fig. ... 12. Harpoceras Kobelli, *Oppel*, Variety, p. 72; specimen without body-chamber from the same bed and locality as fig. 11; 12*a*, side-view; 12*b*, front-view.

Fig. ... 13. Harpoceras Kobelli, *Oppel*, Variety, p. 72; specimen without body-chamber from the same beds and locality as fig. 11; 13*a*, side-view; 13*b*, front-view.

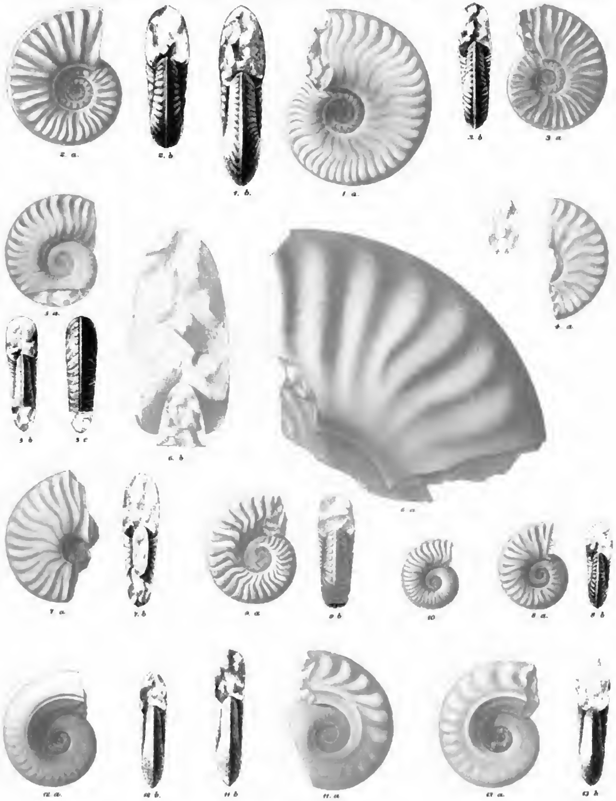

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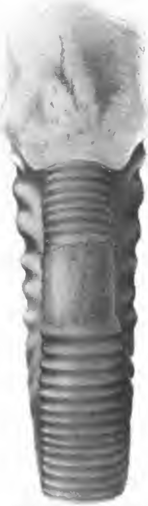
PLATE XIV.

Fig. ... 1. PELTOCERAS SEMIRUGOSUM, *Waagen*, n. sp., p. 83; specimen with the beginning of the body-chamber from the *Dhosa-oolite* of *Lodai*; 1, side-view; 1 *a*, front-view; 1 *b*, lobes.

Fig. ... 2. PELTOCERAS SEMIRUGOSUM, *Waagen*, n. sp., p. 83; small specimen, composed of air-chambers, from same bed and locality as fig. 1; 2, side-view; 2 *a*, front-view.

Figs. ... 3-6. OPPELIA NURRHAENSIS, *Waagen*, n. sp., p. 51; young specimens from the beds with *Per. anceps*, east of *Nurrha*; 3, side-view; 3*a*, front-view; 3*b*, lobes; 4, fragment of a very young specimen; 5, aperture of a young specimen; 6, variety with larger umbilicus.

Fig. ... 7. OPPELIA FORNIX, *Sowerby*, p. 50; copy from Sowerby's figure: Transact. Geol. Soc., Lond., Ser. II, Vol. V, pl. 61, fig. 13.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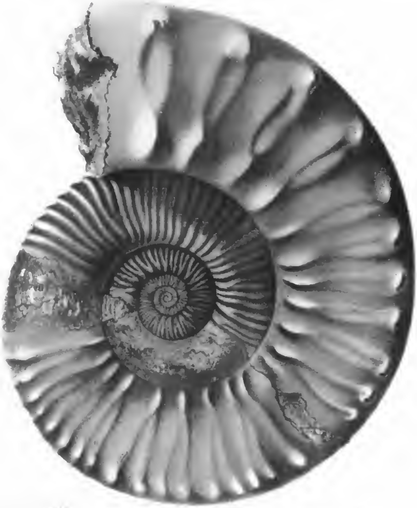
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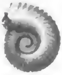
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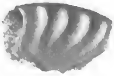
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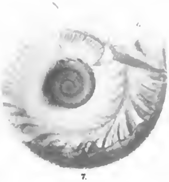
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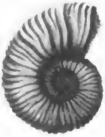
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Palæontologia Indica,
BEING
FIGURES AND DESCRIPTIONS OF THE ORGANIC REMAINS PROCURED DURING
THE PROGRESS OF THE GEOLOGICAL SURVEY OF INDIA.

PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA IN COUNCIL,
UNDER THE DIRECTION OF
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Hon. Mem. of Leop-Carolino Academy of Natural Sciences: of the Isis, Dresden: of the
Roy. Geol. Soc., Cornwall: of the Imp. Soc. of Naturalists, Moscow:
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SUPERINTENDENT OF THE GEOLOGICAL SURVEY OF INDIA.

JURASSIC FAUNA OF KUTCH.
Vol. I. 3.

Ser. IX. 3. The CEPHALOPODA (Ammonitidæ),
by **WILLIAM WAAGEN**, Ph. D.,
Palæontologist, Geological Survey of India.

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That I had been wrong in doing so was proved by Dr. Neumayr,[*] who had more extensive materials of *Aspidoceras* at his disposal than I had here; however, I should not have given up my opinion so easily had I not found among the fossils brought from Kachh by Dr. Stoliczka a specimen of a new species, *Asp. diversiforme*, which showed clearly that the relations of the '*Perarmati*' were different from those of *Peltoceras*.

Thus there can be no doubt, from the characters exhibited by the younger stages of growth of species of both genera, *Aspidoceras* and *Peltoceras*, that the one originates from the group of *Perisphinctes convolutus* or *Martiusi*, to which the larger number of middle jurassic *Perisphinctes* belong; the other, on the contrary, takes its origin from a group of *Perisphinctes*, as yet apparently entirely unknown in the European or any other jurassic strata, and perfectly distinct from the "*convolutus* group."

The genus *Simoceras* is less allied to our genus than *Aspidoceras*, and can easily be distinguished by the strong, deep contractions of the shell, which are characteristic for it.

The number of species which I unite under the name of *Peltoceras* is thus not very large, as only the species allied to *Pelt. annulare, athleta*, and *Arduennense*, belong to it. Thus limited, the genus begins in the upper part of the Kelloway group, and has its last representative in about middle or upper Oxfordian beds. There can be distinguished a series of developmental groups, some of which have been already pointed out by Dr. Neumayr.[†] He mentions three groups, all starting from the single species of *Pelt. annulare*, and then proceeding through the mutations of *P. chauvinianum*, Orb., and *P. Eugeni*, Orb., to *P. bimammatum*, Quenst., in one instance; through *P. torosum*, Opp., *P. spissum*, Opp., *P. Arduennense*, Orb., and *P. transversarium*, Quenst., to *P. reversum*, Leckenb., in another instance, and at last through *P. athleta*, Phill., to *P. constanti*, Orb. Though the species are well picked out and arranged, yet I cannot entirely agree with these statements. First of all I do not think that *P. chauvinianum*, Orb., fits well into the series, but is rather to be considered as an isolated form. Then it seems to me that it is not likely that *P. athleta* can have been derived from *P. annulare* itself. I rather feel inclined to suppose that some as yet undescribed species from older beds has given rise to both of the species, so that *P. athleta* is not subordinate to *P. annulare*, but co-ordinate. Thus my arrangement of the species must necessarily become different, and in consequence of that I distinguish—(1) group of *P. annulare* with the mutations *P. torosum*, Opp., *P. spissum*, Opp., *P. Arduennense*, Orb., *P. reversum*, Leckenb., *P. transversarium*, Quenst.; (2) group of *P. Eugeni*, Orb., to which only doubtfully can *P. bimammatum*, Quenst., be connected; (3) group of *P. athleta*, Phill., with the mutations *P. constanti*, Orb., *Murrayanum*, Simps., and some species of Phillips, too imperfectly described, to enable one to recognise whether they may belong here or not.

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[*] Neumayr: Abhandl. d. k. k. Geolog. Reichsanst., Vol. V, p. 188.

[†] Neumayr: Jahrb. d. k. k. Geolog. Reichsanst., Vol. XXI, p. 369.

All these groups are represented in the Kachh Jura by one or the other species, two of which agree specially with European forms. The first group has furnished two species, *P. aegoceroides*, Waagen, n. sp., and *P. Arduennense*, Orb.; the second only one species, *P. propinquum*, Waagen, n. sp.; the third is represented by three species, *P. athleta*, Phill., *P. bidens*, Waagen, n. sp., and *semirugosum*, Waagen, n. sp.

Of these *P. athleta*, Phill., and *P. Arduennense*, Orb., were observed to occupy in Kachh the same relative geological position which they do in Europe.

(a.) Group of PELTOCERAS ANNULARE, *Rein., sp.*

1. PELTOCERAS AEGOCEROIDES, *Waagen*. Pl. XVI, Fig. 3*a*, *b*.

A very small species, with nearly the whole last chamber preserved, and yet not measuring more than 15 mm. in diameter. From the first stages of growth, the shell is covered with fine, undivided ribs, bent a little backwards, which become strong on the last whorl. I count on the last whorl exactly forty ribs, which are highest on the siphonal side; they are not all equidistant, but some of them are a little closer, and the space between two of those approximated ribs looks like a contraction of the shell, the furrow between them being rather deep. It is apparent that those contractions of the shell, though also indicating margins of the aperture in former stages of growth as in *Perisphinctes*, are different from the sulci occurring in this genus, because here the direction of the sulci is often not the same as the direction of the ribs, and the sulci cut the ribs in more or less oblique an angle, but there they are included between two parallel ribs, indicating thus a more simple apertural margin.

The whorls of the species I am describing are almost not touching each other, so that the siphonal side of the preceding whorl produces nearly no impression at all on the antisiphonal side of the following one. The whorls are rounded, depressed, and very numerous.

The lobes are not distinctly visible on any part of the shell, and I am therefore not able to describe or to draw them.

The measurements are—

Diameter of the shell	15 mm.
„ of the umbilicus	7
Height of the last whorl	4·25
Thickness of the „	4·5

Remarks.—The only specimen of this species I have for description is from Joora out of a brown fine oolite, which contains at the same time *Aspid. perarmatum*. The species is very nearly allied to young specimens of *P. Arduennense*, *torosum*, and *spissum*, but is distinguishable by its single ribs, which never occur in so small examples of the species just mentioned, and by the depressed form of the whorls. *Pelt. aegoceroides* is a member of a lower Oxfordian fauna of the beds with *Asp. perarmatum.*

2. Peltoceras Arduennense, *Orb. sp.* Pl. XVI, Fig. 2*a*, *b*.

1847. *Ammonites Arduennensis*, Orbigny: Pal. Franç. Terr. Jurass., I, p. 500, pl. 187, figs. 4—7.

I have figured on pl. 16, fig. 2, a small example of an Ammonite, which I believe to be the young stage of *Pelt. Arduennense.* The whorls are finely ribbed, the ribs are dichotome, sometimes trichotome, just as is figured by Orbigny on the inner whorls of his *Amm. Arduennensis*, and are most prominent on the siphonal side of the whorl. The shell is very slightly involute, the transverse section of the whorls is a little compressed, somewhat rectangular. The lobes are not visible.

Remarks.—The determination of this specimen is not quite certain, because the young examples of a large group of forms allied to *Pelt. Arduennense* are so similar in their whole appearance that it is difficult to attribute them to the one or the other species. I can state only with certainty that the figured example does not belong to any of the other Indian species. But as the specimen showed great resemblance to the Oxfordian form, I put it under this name with the purpose of showing that there is in India a species which I cannot distinguish at that stage of growth from *Pelt. Arduennense.*

The locality which has furnished the specimen is the Joora hills, where it occurs in the Dhosa oolite.

(b.) Group of Peltoceras Eugeni, *Raspail.*

1. Peltoceras propinquum, *Waagen, n. sp.* Pl. XVI, Fig. 1*a*, *b*.

Though only one specimen of this species is in the possession of our Museum, I thought it yet advisable to describe it under the above name, as it seems to furnish a certain connecting link between *Pelt. Eugeni* and *bimammatum.*

Young specimens are in this species, more than in any other except *P. athleta*, like *P. annulare*, Rein. Up to a diameter of about 40 mm. the shell changes very little in its general appearance. The whorls are rounded in their transversal section, rather depressed, only very little higher than broad. They are covered with not very fine sharp ribs, which are for the greater part dichotome, sometimes single, very rarely one of the secondary branches is yet again divided into two. The point of division of the ribs is not near the umbilical margin, but about in the middle of the sides. Contractions of the shell do exist, but are very rare. In somewhat larger specimens, up to a diameter of about 90 to 100 mm., the ribs are simple, first numerous, and not very high, then more and more increasing in distance and strength, but yet without any tubercles. As in younger specimens, they cross as high simple ridges over the siphonal side, but bear here, not as in former stages of growth, a little depression, like young specimens of *P. bidens*, W.

When the shell attains a diameter of about 100 mm. tubercles appear rather suddenly on the ribs, one compressed and pointed near the umbilical margin, and one thick and rounded on the margin of the siphonal side. The ribs pass yet on over the siphonal part of the shell, but in the middle of it they are interrupted by a deep, not very broad furrow, which passes along there, but they do not bear any tubercles on each side of the furrow. In very large specimens, it seems the tubercle, which is situated at the margin of the siphonal side of the whorl, more and more approaches the furrow, whilst the tubercles on the umbilical margin become smaller and less distinct, and thus the last part of the shell of *P. propinquum* resembles more or less a gigantic specimen of *P. bimammatum*.

In this full grown state the general shape of the shell is patelliform, with very wide umbilicus and whorls, squarish in their transversal section, with flattened siphonal part, intersected by the thick swollen ribs which pass over it, and provided with a longitudinal furrow. The umbilicus is never surrounded by a distinct vertical wall, and such an umbilical edge is never developed.

The form of the lobes I can only gather from different bits being exposed on different parts of the shell. The siphonal lobe is tolerably long and narrow with a long straight branch on either side ; external saddle very broad, with a short but well developed secondary lobe not quite in the middle of it, but a little shifted towards the first lateral lobe ; the latter very long, a good deal longer than the siphonal, with a long medial terminating branch ; first lateral saddle very broad, with a well developed eccentric secondary lobe, limited towards the umbilicus by a small little developed sutural lobe, second lateral and every auxiliary lobe thus wanting.

The measurements of the described specimen are—

Diameter of the shell	123 mm.
„ of the umbilicus	63
Height of the aperture from the umbilical suture	39
„ of the „ from the preceding whorl	38
Thickness of the „	36

There are yet fragments of a much larger outer whorl of the same specimen.

Remarks.—The specimen just described was found by Dr. Stoliczka north-west of Kumagoona in a yellow sandy calcareous rock, belonging very likely to the region of *Asp. perarmatum*, but possibly also a little higher.

The species is nearly allied to several others, principally to *P. Eugeni*, Orb., *P. bidens* and *semirugosum*, W. The full grown stage of *P. propinquum* is always easy to distinguish from the forms mentioned: from the first by the want of tubercles on either side of the furrow on the siphonal part of the shell; from the second and third by the ribs which cross over the siphonal side, whilst this part of the shell is entirely flat in *P. bidens* and *semirugosum.* Young specimens of the four mentioned species are not so easily distinguishable; however, on closer examination, constant differences can be discovered.

In the inner whorls of *P. Eugeni* the ribs are less numerous and more distant, and never bidichotomous as is often the case in *P. propinquum.* In *P. semirugosum* the ribs are much coarser and divided near the umbilical margin, not on the middle of the sides; in *P. bidens* they are mostly simple, undivided, and in *P. Arduennense,* which must be also compared, they are much finer than in all the others. In this way *P. propinquum* in all its stages of growth can be distinguished from the allied forms.

(c.) Group of PELTOCERAS ATHLETA, *Phill.*

1. PELTOCERAS ATHLETA, *Phillips, sp.* Pl. XVII, Figs. 2*a*, *b*, 3*a*, *b*, *c*.

1829. *Ammonites athleta,* Phillips: Geol. of Yorkshire, ii, pl. 6, fig. 19.
1847. *Ammonites athleta,* (Phill.), Orbigny: Pal. Franç. Terr. Jurass., Vol. i, p. 457, pl. 163 & 164.
1848. *Ammonites athleta,* (Phill.), Quenstedt: Die Cephalopoden, p. 189, pl. 16, figs. 1—3.
1857. *Ammonites athleta,* (Phill.), Oppel: Jura formation, p. 556.
1858. *Ammonites athleta,* (Phill.), Quenstedt: Der. Jura., p. 538, pl. 71, figs. 1—3.

Though fragments of the species are rather common in Kachh, an entire specimen has not been found as yet, and principally the inner whorls, so characteristic for the species, are never preserved.

The shape of the young form I can only guess from the impressions it left on the antisiphonal side of the outer whorls of larger examples, and I see there that its siphonal side was provided with fine sharp ribs, as in European specimens of *P. athleta.*

The Indian specimens seem to have got their spines at a rather early state of growth, but not earlier than some of the specimens found in Württemberg, of which one is figured in Quenstedt's "Cephalopoden," which had got the outer row of spines at 25 mm. diameter, and had already with 45 mm. diameter an entirely smooth siphonal side. This seems about the variety which resembles most closely the Indian form. In specimens whose diameter I estimate at about 50 mm. both rows of spines are already well developed, the outer a good deal stronger than the inner, the siphonal side is nearly entirely smooth, and only faint traces of the ribs, which go over it from one spine to the other opposite, are visible. The transversal section of the whorls is rectangular, a little higher than broad. This shape remains apparently till the specimens grow very big; at least fragments, which are derived from specimens of at least 180 to 200 mm. diameter, show yet the same form, only the spines are comparatively a little weaker. The corresponding spines of the different rows on either side of the whorls are connected by low ribs, which have sometimes a longitudinal depression on their top.

The lobes do not agree entirely with those figured by Orbigny in his 'Paléontologie Française,' but differ in several points. The siphonal lobe is tolerably broad, well divided, with two principal branches, external saddle very broad with two secondary lobes, one larger near the siphonal and one smaller near the first lateral lobe; first lateral lobe not much longer than the siphonal, rather narrow, well branched; first lateral saddle about as long as the external, not very broad, with a small central secondary lobe; after that there are yet two smaller lobes, placed under a certain angle towards the first lateral; the first of them not very large, unsymmetrical, the second a little larger, forming a kind of second lateral lobe, but already half concealed in the umbilical suture.

The measurements of two of the fragments are—

	Larger fragment.	Smaller fragment.
Height of the aperture	63 mm.	25 mm.
Thickness of the " between the ribs	51	24
" of the " on the ribs between the tubercles ...	85	27

Remarks.—The fragments of this species preserved in our Museum were collected at the following localities: north and north-east of Gudjinsir, in whitish, marly limestone, the shell of the fossils being converted into black calcspar,—fragments of four specimens; north-west of Jikli—a fragment in yellowish marly limestone; Vanda—a fragment out of a rock of the same description; north-west of Soorka hill—two fragments out of light grayish limestone, the shell of the fossils converted into black calcspar; north-west of Nurrha—a fragment exactly preserved like those of Gudjinsir or Soorka hill; south-west side of Keera hill near Charee—a fragment also preserved in the same way.

It will be easily seen from the drawings given on pl. 17 that the general form of the Indian specimens agrees well with that of the European *P. athleta*. However, they show not quite the typical shape, but rather resemble certain varieties which also occur in Europe, but are there not so common as the typical form. The most prominent difference lies in the siphonal side, where the three ribs which start from every spine on one side and are again united in the spine of the other side disappear at a comparatively early state of growth in the Indian specimens, whilst in the European ones they commonly remain much longer; this difference, however, is certainly not sufficient to separate both forms as different species.

Peltoceras athleta is in Europe most characteristic for upper Kallovien beds.

2. Peltoceras semirugosum, *Waagen, n. sp.* Pl. XIV, Figs. 1, 1*a*, 1*b*, 2, 2*a*.

The species described under this name is very remarkable. The changes which the species undergoes from its first youth to its full grown stage are so large that I have to describe them as if there were at least four different species. The general form of the shell is always patelliform, with very wide umbilicus, and rather compressed whorls.

From the first beginning of the shell, up to a diameter of about 15 mm., the whorls are rounded, and covered with sharp, fine, dichotome ribs, which pass over the rounded siphonal side; only the embryonal chamber and the first whorl are smooth, without any ornamentation. Growing larger, the whorls become more and more high, and at the same time the transverse section of them becomes more angular, the siphonal side being now rather flat; the ribs, which were on the former whorls divided in two on the middle of the sides, have now their dichotomism near the umbilical margin. This state remains up to a diameter of about 80-90 mm. The shell at that time resembles *Pelt. Arduennense* extremely, so that I for a long time was in doubt if I should not join the Indian form with Orbigny's species. But after a careful examination I found that even at that stage of growth there are some differences between the two species which make it possible to separate them, though, only knowing this stage, I would not have considered them sufficient for specific distinction. The ribs in *Pelt. semirugosum* are straighter, and more distinctly dichotome, so that I have never observed trichotome ribs as is often the case in *Pelt. Arduennense.*

Exceeding a diameter of 90 mm. the aspect of the shell becomes quite different, and one would certainly determine a fragment from this stage, as *Pelt. constanti*, Orb. The transverse section of the whorls is high, and nearly rectangular; the ribs are very regularly dichotome, and every one bears a strong tubercle on the outer margin; from there low ribs pass over the flat siphonal side, which, however, disappear nearly entirely at a diameter of the shell of about 110 mm. At this size the points near the umbilical margin, where the ribs are divided into two, become successively higher and thicker, and two of the ribs unite now commonly into one outer marginal tubercle. So the shell gets very soon two rows of tubercles, one near the umbilical and one near the outer margin, and then only has it arrived at its permanent state.

The species grows astonishingly large. I believe it is one of the largest forms existing among the *Aspidoceras*-like types. There is here preserved a fragment of the outer whorl of such a gigantic example, of which the aperture is about 120 mm. high and 95 mm. broad, though the preceding whorl at the same radius has only 70 mm. in height and 55 mm. in breadth. This shows clearly the rapid increase of the whorls in this species. In the inner whorls of course the increase seems a little slower, but there is only a slight difference.

The lobes are of the characteristic form of the whole group. The siphonal lobe is not very broad, a little shorter than the first lateral one; the external saddle is extremely broad, with a secondary lobe, which is not quite preserved in the figured example.

The lateral lobe is very long and terminates in a long narrow branch; the lateral saddle is much smaller than the external, provided, however, with a secondary lobe, but not going higher up than the latter; the second lateral lobe is very indistinct, and nearly of the same shape as the auxiliary lobe. The second lateral saddle is very small, but distinct and bearing a small secondary lobe. Beginning from the first lateral saddle all the lobes and saddles hang down, forming thus a large sutural lobe.

The dimensions of the figured example are—

Diameter of the shell	158 mm.
„ of the umbilicus	66
Height of the last whorl from the umbilical suture	55
„ of the „ from the preceding whorl	52
Thickness of the „	41
Height of the preceding whorl from the umbilical suture	28
Thickness of the „ „	22

Remarks.—The examples I have to examine are several, all coming from Lodai and Joora, out of a brownish, fine oolite, which very often passes into a hard, calcareous crinoidean breccia. The fossils are mostly covered with a ferruginous crust. The shell is commonly preserved and converted into iron ore or into a white kalkspathic matter.

As I have already mentioned before, ***Pelt. semirugosum*** shows great affinities to several already described species, so that it is difficult to distinguish it at certain stages of growth. The first species which comes into consideration here is ***Pelt. Arduennense***, but one can compare both species only up to a diameter of 80-90 mm.—exceeding this, no one would think them both identical. That also the younger specimens are distinguishable by straighter and regularly dichotomous ribs I mentioned before. The example figured by Orbigny is not large enough to state with all necessary certainty if the species, on growing larger, could not have got also, like our species, two rows of thorns on both sides of the whorl, and such could not be identical with the form here described; but firstly Orbigny states it as characteristic for his species, that it never gets thorns, and then, on the other hand, Quenstedt in his 'Jura' mentions fragments of the body-chamber of ***Pelt. Arduennense*** from the "Vaches noires" of about 40 mm. high and 26 mm. broad—dimensions in which our species has already for a long time had its spines. That there is at the "Vaches noires" also a species which gets spines in the larger stages of growth there is no doubt, because I found once there a fragment of an Ammonite which on the inner whorl resembled very much ***Pelt. Arduennense***, whilst the outer whorl had two rows of spines, but I do not remember it exactly enough to determine if it be identical with one of the Indian species or not.

Before ***Pelt. semirugosum*** gets its two rows of tubercles, there is a short space of the shell which very much resembles ***Pelt. constanti***, having only on the outer side of the whorl one row of spines.

That for this reason our species is not to be united with ***Pelt. constanti*** is natural, because ***P. constanti*** has its characteristic form for several whorls, without getting a second row of spines, but our species, on the contrary, has this form only for not quite half of a whorl, then already putting on the umbilical row of spines.

Full grown examples are not easy to distinguish from larger specimens of ***Asp. perarmatum;*** both have two rows of tubercles, the outer one being stronger than the inner, but on ***Pelt. semirugosum*** the inner whorls are so entirely different from those of ***Asp. perarmatum*** that nobody would think of uniting both species into one.

There seems little doubt that the species is of Oxfordian age. It seems to come from the same layer as ***Pelt. Arduennense*** and ***Asp. perarmatum***, which both indicate in Europe Oxfordian strata, and are there found exclusively in the lowest region of that division.

3. PELTOCERAS BIDENS, *Waagen, n. sp.* Pl. XV.

Like the species just described, this also is subject to great changes according to age, but the changes are a little different from those occurring in the other.

The first stages of growth, up to a diameter of about 25 mm., have a large umbilicus and rounded whorls with strong not very fine ribs; about half the number of them is single, the other half divided into two. The siphonal side is rounded, and the ribs pass over it in the same shape as they are developed on the sides of the whorl. When the shell attains a diameter of more than 40 mm., the transverse section of the whorls becomes oval, much higher than broad, the ribs are strong, and all undivided, and on the now somewhat flat siphonal region they are swollen on both sides, forming in a way two rows of obtuse tubercles. At this stage the species has the most characteristic form; growing larger it attains again an appearance very much like ***Pelt. semirugosum***, but notwithstanding that, there are yet always some distinguishing points. In specimens exceeding a diameter of 90 mm. on the outer side of the whorls, following the margin where the flat siphonal side joins with the sides of the whorls, tubercles appear which soon correspond with smaller ones on the umbilical margin, so that the whole form very much resembles ***Aspidoceras perarmatum.***

Of the species here in question I have not yet seen such large fragments as of ***Pelt. semirugosum.*** The largest example known to me has 340 mm. in diameter, and is figured on pl. XV, fig. 1, ⅔ of its natural size.

The sutures are very much like those in other allied species, the siphonal lobe not very long, finely dentated, the external saddle extremely broad, with a large secondary lobe next to the siphonal lobe, and a small one next to the first lateral lobe. First lateral lobe much longer than the siphonal, with rather broad and elongated body, terminating in one narrow long branch. The first lateral saddle is much smaller than the external, provided with a secondary lobe; second lateral lobe of the same shape as this secondary one, yet less distinct than in the preceding species; second lateral saddle not distinguishable, those last two hanging down to a large sutural lobe.

The dimensions of the large specimen are—

Diameter of the shell	340 mm.
„ of the umbilicus	170
Height of the aperture	90
Thickness of the „ about	75

Remarks.—*Peltoceras bidens* is very nearly allied to a whole group of Ammonites which are not easy to be distinguished, and it seems therefore desirable to go through all the single forms, and to state the specific value of every one of them.

On reviewing the species, which come here into consideration, it is easy to find that there are two groups of forms, those which never bear points or spines, and those which in full grown age are covered with them. Though the first group seems not to come into comparison with the species here described, it is yet necessary to mention those also, because the young stage of our species is very nearly allied to them. We have to consider here only the species with squarish or angular aperture, and I begin them with—

Pelt. Arduennense, Orb. The ribs are fine, dichotome or trichotome, and, at a diameter of about 300 mm., the shell is not yet provided with thorns. Zone of *Am. Lamberti* and that of *Am. cordatus.*

Pelt. spissum, Opp. The ribs fine, mostly single, a little bent backwards; no examples with spines or thorns known. Zone of *Am. Lamberti.*

Pelt. torosum, Opp. Aperture more rounded, ribs in the beginning mostly dichotome, on the last whorl thick, single, and strongly bent backwards; no specimen with spines known. Zone of *A. Lamberti.*

Pelt. reversum, Leckenby. Depressed, rather roughly ribbed; ribs dichotomous to the end, strongly bent backwards. Near the mouth apparently traces of spines on the umbilical margin. A very characteristic species, but its layer not exactly known (Kelloway rock of Yorkshire).

Pelt. transversarium, Quenst., (identical with *Pelt. Toucasianum,* Orb.) Ribs very strong and little numerous, single or dichotome near the umbilical margin, strongly bent backwards; no spines. Middle Oxfordian.

Pelt. Eugeni, Orb. Whorls rather rounded, ribs mostly dichotome, becoming simple at a diameter of about 50 mm., forwarded with two rows of spines on the sides of the whorls, and two on the siphonal side. Very rare species of the zone of *Am. cordatus.*

Pelt. propinquum, Waagen, n. sp. Whorls rather rounded, ribs distant, often bidichotome; at a diameter of about 100 mm. two rows of spines on the sides of the whorls, and a depression on the siphonal side.

Pelt. Constanti, Orb. Whorls rectangular, ribs dichotome near the umbilical margin, getting spines on the outer margin at a diameter of about 50 mm., spines near the umbilicus wanting. Zone of *Am. cordatus.*

Pelt. Murrayanum, Simpson. Whorls very compressed, twice as high as broad, in adult examples provided with two rows of tubercles (diameter about 300 mm.) (Kelloway rock of Yorkshire).

Pelt. semirugosum, Waagen. Young stage up to 90 mm. very much like *P. Arduennense,* but the ribs straighter and strongly dichotome. Full-grown, (from a diameter of about 110 mm.) with two rows of tubercles on the sides of the whorls. Aperture a little higher than broad.

Pelt. bidens, Waagen. Young stage with strong single ribs; on the siphonal side two rows of not very distinct tubercles. Full-grown, two rows of thorns on the sides of the whorls; thorns less numerous than in the preceding species; whorls much higher than broad. Dhosa oolite of Cutch.

? ? Pelt. armiger, Sow. A very doubtful species, which I cannot make out either from the description or from the figure. The description given by Sowerby is: "Discoid, inner volutions exposed, inner whorls radiated and furnished with a row of tubercles on their sides; outer whorls with a row of tubercles near the inner edge, and a row of spines near the outer edge; on each side the tubercles and spines connected by thick ribs; margin flat, aperture oblong, squarish, diameter 7 inches." I have never seen a species with tubercles on the inner whorls as this is described and figured by Sowerby, and it is certain that among the materials in the possession of our Museum not a single specimen like it is preserved.

Other doubtful species, the meaning of which only can be settled by examining the originals, which served for description, are *Pelt. Williamsoni,* Phill., resembling *Pelt. bidens,* but with depression of the ribs on the siphonal side nearly absent and a more squarish aperture, *Pelt.? instabile,* Phill., and *Pelt. Vernoni,* Phill., possibly, if a *Peltoceras,* identical with *Pelt. Arduennense,* Orb.

These are the forms allied to my species. It is easy to be seen, that even with a few short sentences one is able to signify the distinctive points between the several species. I only wish to make a few additional remarks regarding the lobes of *Pelt. semirugosum* and *bidens,* considering that in the first species the second lateral saddle is distinct, provided with a secondary lobe, whilst in the second one the same saddle is quite indistinct, not different from any auxiliary saddle.

The examples for description are several, coming from the same brown oolite as the preceding species, partly from Joora, partly from Lodai, and, as far as I can judge from other species, being a member of a fauna of lower Oxfordian age.

GENUS *ASPIDOCERAS*, ZITTEL.

Though the name of *Aspidoceras* was used by Zittel already in 1868, it was not before the year 1870 that he gave a diagnosis of the genus. Since then many excellent observations about the genus have been published by Dr. M. Neumayr, and many of the difficult and often obscure relations of it to other generic forms have been cleared up. But it was not without difficulty that these results had been obtained, and thus even Dr. Neumayr in his newest publication had to change the opinions he had expressed in 1871 in the Jahrbuch of the "Geologische Reichsanstalt" of Vienna. This shows clearly what intricate questions he had to deal with, and how only the most extensive materials, like those which Dr. Neumayr had at his disposal for his last memoir, could lead towards a definitive solution.

Also I was myself misled by the affinities of certain species of *Aspidoceras* to transfer them into my new genus *Peltoceras*, which has been shown, as well by the remarks of Dr. Neumayr as by my own observations, to be erroneous.

As the question now stands, one can say with tolerable certainty that the genus *Aspidoceras* takes its origin from certain forms of the genus *Perisphinctes*, and that the first species, in which the peculiarities of the genus are well developed, and which, therefore, must be considered as truly deserving the name, are *Asp. perarmatum*, or rather *Asp. diversiforme*, Waagen, n. sp., which I am going to describe in the following pages.

Thus defined, the genus commences in the beds with *Pelt. athleta*, and continues up to the lower cretaceous formation, having its greatest development in the Kimmeridge and lower Tithonian group.

It is easy to distinguish three principal sections in the genus: the '*Perarmati*,' the '*Cycloti*,' and the '*Hybonoti*.' The two first of these are in every respect very nearly allied to each other, though in fact the only really connecting link between them is *Asp. perarmatum;* the third section, connected with the *Perarmati* through *Asp. pressulum*, Neum., deviates, however, so far from the original type of the *Aspidoceras* that it will be necessary to create a new generic designation for them, principally as the sculpture on most of the species strongly bent on the siphonal side of the shell towards the aperture indicates an apertural margin somewhat different from that usual in the genus *Aspidoceras*. The materials at my disposal are, however, not sufficient to establish a new genus, and thus I can only call attention to the existing differences.

The developmental series in the different sections of the genus have been pointed out already with great care by Dr. Neumayr, with whose views about most of the species I agree perfectly. In the section of the '*Perarmati*' I can distinguish: (*a*), group of *Asp. perarmatum*, Sow., with the mutations *Asp. Oegir*, Opp., *Asp. eucyphum*, Opp., *Asp. hypselum*, Opp., *Asp. clambum*, Opp., etc.; (*b*), group of *Asp. biarmatum*, Ziet., or better of *Asp. ponderosum*, Waagen, a new species of the Athleta-beds of Kachh, with the mutations *Asp. biarmatum*, Ziet., and *Asp. Babeanum*, Orb.; (*c*), group of *Asp. distractum*, Quenst., with the mutations *Asp. Edwardsianum*, Orb., *Asp. Meriani*, Opp., *Asp. corona*, Quenst., and *Asp. Rupellense*, Orb.

The section of the '*Hybonoti*' comprises only one developmental series, the group of *Asp. pressulum*, Neum., with the mutations *Asp. Knopi*, Neum., *Asp. harpephorum*, Neum., *Asp. Beckeri*, Neum., and *Asp. hybonotum*, Opp.

The section of the '*Cycloti*' offers great difficulties in arranging the species into developmental rows, and it is mostly in this section that I cannot quite agree with Dr. Neumayr's views. In my opinion the *Cycloti* can be divided into about five different groups, which are the following: (*a*), group of *Asp. Haynaldi*, Neum., with the mutations *Asp. microplum*, Opp., and *Asp. Wolfi*, Neum,; (*b*), group of *Asp. longispinum*, Sow., with the mutations *Asp. acanthicum*, Opp., *Asp. bispinosum*, Ziet., etc.; (*c*), group of *Asp. atavum*, Opp., with the mutation *Asp. binodum*, Opp.; (*d*), group of *Asp. liparum*, Opp., with the mutations *Asp. circumspinosum*, Opp., *Asp. Altenense*, Orb., *Asp. Lallierianum*, Orb., etc.; (*e*), group of *Asp. Neoburgense*, Opp., with the mutations *Asp. cyclotum*, Opp., and *simplum*, Orb.

Thus we can altogether distinguish in the genus *Aspidoceras* not less than nine different groups.

Every one of these groups is, however, not represented in the Kachh Jura. We have here—

I—in the section of the *Perarmati:* (*a*), group of *Asp. perarmatum*, Sow., represented by *Asp. perarmatum*, Sow., and *Asp. tenuispinatum*, Waagen, n. sp.; (*b*), group of *Asp. ponderosum*, Waagen, represented by *Asp. ponderosum*, W., *Asp. Babeanum*, Orb., and *Asp. sparsispinum*, Waagen, n. sp.; (*c*), group of *Asp. distractum*, Quenst., represented by *Asp. sub-distractum*, Waagen, n. sp.

II—in the section of the '*Hybonoti:*' group of *Asp. pressulum*, Neum., represented by *Asp. monacanthus*, Waagen, n. sp., and another not well determined species.

III—in the section of the *Cycloti:* (*a*), group of *Asp. longispinum*, Sow., represented by *Asp. iphiceroides*, Waagen, n. sp., and *Asp. Wynnei*, Waagen, n. sp.; (*b*), group of *Asp. atavum*, Opp., represented by *Asp. binodiferum*, Waagen, n. sp., and another undeterminable species.

There has also been found in the Kachh Jura, together with *Pelt. athleta*, an isolated species, which could not be attributed to any of the groups just mentioned, and from which possibly two genera, *Aspidoceras* and *Simoceras*, could be derived; I call this species *Aspidoceras diversiforme*, Waagen, n. sp.

Of all the species mentioned only two are common to the Kachh and the European Jura; they are *Asp. perarmatum*, Sow., and *Asp. Babeanum*, Orb. Both are found in Kachh, absolutely as in Europe, just above the beds with *Pelt. athleta*.

Section I.—PERARMATI.

(a.) ISOLATED SPECIES.

1. ASPIDOCERAS DIVERSIFORME, *Waagen, n. sp.* Pl. XVII, Fig. 1*a, b, c, d.*

It is only a fragment, not very excellently preserved, which leads me to the foundation of this species, but the development of the shell as exhibited by this fragment, and the conclusions which may be deduced from it, seemed to me sufficiently interesting to justify the distinction of a new species.

The fragment indicates a specimen of about 170 to 180 mm. diameter. The general shape of the entire specimen was patelliform, with a very wide umbilicus and compressed whorls. The inner circuits are not preserved, but from the impression they left on the antisiphonal side of the outer whorls one can observe that, at a diameter of the shell of about 50 mm., they were covered with fine ribs, which were, however, less in number on the sides of the whorls; on the siphonal side they are directed slightly towards the front, and vanish in the middle, where they give space to a broad, smooth, but not excavated band, which occupies the middle of the siphonal side. This latter part is not depressed, but equally rounded, At a diameter which may have been about 80 mm., the sides of the whorl bear fine low, but distant ribs, which are nearly entirely straight, and are strongest near the umbilical margin. On the outer margin each of them is dissolved in three or four smaller ones, which are rounded and rather strong, but very short, not reaching the middle of the siphonal side, where the smooth band yet continues. At that size, the siphonal side is rather depressed, from which the whorl gets a somewhat rectangular section.

The last whorl has an entirely different shape from the foregoing ones, though it is not body-chamber, but filled with air-chambers. It is strongly rectangular, with flat siphonal, and straight lateral parts. The latter are covered with rather strong rounded ribs, every one of which bears two tubercles, one a short distance above the umbilical, and another on the outer, margin. The siphonal side is smooth, without any ribs.

The involution is very small, and all the whorls envelope each other very little.

The lobes are characteristic of the general typical shape prevailing in the genus. The siphonal lobe is not very broad and moderately long, with two long terminal and two side branches; external saddle broad, with a well developed median secondary lobe; first lateral lobe very broad, longer than the siphonal, with five unsymmetrical end-branches, of which the middle one is very long; lateral saddle narrow, with a small secondary lobe, going a very little higher up than the external; second lateral lobe very small, little branched; sutural lobe sending two branches above the umbilical suture, looking like two auxiliary lobes. On the antisiphonal side the well branched sutural lobe is limited by a narrow, very long saddle, which goes up as high as the lateral saddle. The antisiphonal lobe is extremely long and slender, as long as the first lateral, with many short branches on either side.

Remarks.—The fragment upon which this species is founded has been collected in the *Athleta*-bed a long distance north-east of Gudjinsir by Dr. Stoliczka.

Asp. diversiforme is in reality a thoroughly intermediate species between several genera of Ammonites, and thus it may be well adapted to throw some light upon the developmental connections of these genera. There is certainly no doubt that the former stages of development in *Asp. diversiforme* are so nearly allied to certain forms of *Perisphinctes*, principally of the group of *P. convolutus*, that, if the outer whorls of the shell had not been known, it would have been described as *Perisphinctes*. The only difference from the *convoluti* is the flat band on the siphonal side, which is something exceptional, though not astonishing, in the group of *Perisphinctes* just mentioned.

Somewhat larger specimens, showing a diameter of about 80 mm., bear yet great resemblance to the genus *Perisphinctes*; however, this resemblance is no longer as striking as in somewhat smaller individuals. The now flattened, smooth siphonal side on the contrary makes it doubtful if the species had not been better considered as belonging to Zittel's genus *Simoceras*, which, from Dr. Neumayr's discoveries, is also very nearly allied to *Perisphinctes*. The reasons why I did not consider the species as belonging to *Simoceras* are: the higher whorls and smaller umbilicus, the scarce and faint contractions of the shell, and, above all, the lobes which are so completely of the type generally observed in the *Perarmati* that it seems not possible to make a distinction.

Full sized specimens must be related already by their general appearance either to the genus *Peltoceras* or *Aspidoceras*. It cannot be referred to the former on account of its different inner whorls, which agree much better with the inner whorls of *Asp. perarmatum* than with any other, and as the lobes equally tend to show the relations of the species to the *Perarmati*, I thought it best to unite it with the genus *Aspidoceras*.

On the whole, *Asp. diversiforme* shows so many affinities to *Aspidoceras*, as well as to *Simoceras*, that I am inclined to consider it as the *root species* of the two genera.

(b.) Group of ASPIDOCERAS PERARMATUM, *Sow.*

1. ASPIDOCERAS PERARMATUM, *Sow.* Pl. XVI, Figs. 4*a*, *b*, 5*a*, *b*, 6, 7.

1822. *Ammonites perarmatus*, Sowerby: Min. Conch., IV, p. 72, pl. 352.
1847. *Ammonites perarmatus*, (Sow.) Orbigny: Pal. Franç. Terr. Jurass., I, p. 498, pl. 184, 185, figs. 1-3.
1866. *Ammonites perarmatus*, (Sow.) Oppel: Zone des Amm. transversarius, p. 13.
1871. *Aspidoceras perarmatum*, (Sow.) Neumayr: Jahrb. d. k. k. Geolog. Reichsanst., Vol. xxi, p. 371, pl. 20, fig. 1.

A series of several excellent specimens of this well known European species has been collected at Vanda, the Joora hills and Lodai, allowing of a rather accurate description and determination.

The younger stages of growth are represented in two varieties, which are rather different in their general aspect. The smaller specimen has 22 mm. in diameter. The whorls are much higher than broad, rounded squarish, embracing each other very little, umbilicus tolerably wide. The sides of the whorls are covered with fine, not very prominent ribs, of which commonly the third one is thicker and stronger; at the rounded outer margin, the thinner ones are divided each into two or three finer ribs, which pass, a little bent towards the front, over the siphonal part of the shell; the thicker ones terminate on the same margin in a kind of tubercle, produced by a strange curvature of the rib as in *Perisphinctes curvicosta*, Opp. Starting from the tubercle two distinct ribs go over the siphonal side, one forming a half circle towards the front, the other rather straight.

On a specimen of 30 mm. diameter I am able to observe what changes in form the species undergoes on growing a little larger. In this specimen the shape is in every detail identical with that formerly described up to a diameter of 20 mm. Then the tubercles at the outer margin are already rather prominent and pointed, the ribs on the sides of the whorls connected with them are very strong and distinct, whilst between them only one weaker rib is visible, but yet the siphonal side is not smooth, but the ribs cross over it. At a diameter of 27 mm. the first little spine near the umbilical margin appears, and only now is the typical form of the species established, but with the difference, that at this size only the principal ribs bear an outer and an inner tubercle, whilst the intercalated lower ribs are provided only with an outer tubercle. Sometimes one or the other of the principal ribs is divided into two at the inner tubercle, and then two outer tubercles correspond to one inner one. The general form of the shell now changes only very little; large as the specimens may grow, only the ribs which connect the corresponding tubercles of the two rows become weaker and weaker, and the siphonal side gets more and more smooth. The transversal section of the whorls is then obtuse rectangular, a little narrower at the outer than at the umbilical margin. The umbilicus is wide open, the whorls barely touching each other.

The tubercles are commonly not very numerous in large specimens, but one of the specimens from Vanda is conspicuous by the great number of spines which it bears on the last whorls.

The lobes are commonly slightly different from what Neumayr describes in the European specimens; they are mostly narrower and comparatively longer, but not much more ramified. The siphonal lobe is very long and comparatively narrow, with four principal branches; external saddle extremely broad with two secondary lobes, one smaller near the siphonal and one larger near the first lateral lobe; first lateral lobe not quite as long as the siphonal, very slender, terminating with two principal branches; first lateral saddle a little variable in its breadth according to the interference of the hollow spines at the umbilical margin, with a small secondary lobe; second lateral lobe (if one can call this lobe such) very small; sutural lobe yet entirely above the umbilical suture.

The measurements of three specimens, two from Vanda, one from Lodai, are the following:—

		I.	II.	III.
Diameter	of the shell	31 mm.	100 mm.	200 mm.
"	of the umbilicus	12	42	91
Height	of the aperture from the umbilical suture ...	12	38	63
"	of the " from the preceding whorl ...	10·5	36	61
Thickness	of the "	12	42	62

Remarks.—The best specimens of this species have been found at Vanda in a strongly ferruginous oolite just above the white limestone with *Peltoc. athleta.* The other specimens, which were collected at Lodai in a sandy oolite, at the Joora hills in brown ferruginous oolite, at Kumagúna north of Warar hill in whitish oolite, north of Jumara in a brown sandy oolite, and on the south-west side of Keera hill near Charee also in yellowish sandy oolite occupied the same position. A very badly preserved fragment from the red ferruginous sandstone of Kuntkote can only with doubt be considered as belonging to this species.

Neumayr has with great skill pointed out the differences between *A. perarmatum* and the other allied species, and I have nothing to add to what he says. From *P. bidens* and *semirugosum* Sowerby's species can easily be distinguished by the shape of the inner whorls and of the tubercles, which are much finer and more pointed.

Asp. perarmatum is one of the most characteristic and most common species of the European Jurassic districts, and occupies there the same bathrological position as in Kachh, immediately above *P. athleta.*

2. ASPIDOCERAS TENUISPINATUM, *Waagen, n. sp.* Pl. XVII, Fig. 4*a*, *b*.

The species stands about in the middle between *A. perarmatum*, Sow., and *A. Edwardsianum*, Orb., and is about equally different from both of them.

The inner whorls of the only specimen of this species I have for description, up to a diameter of about 20 mm., are covered with equidistant rather strong ribs, which bear a kind of elongated tubercle at a little distance from the umbilical margin. The ribs are rather strongly directed towards the front from the umbilical suture to the middle of the sides of the whorls, but then turn back again a little. Between the principal ribs there are, when the shell of the fossil is preserved, yet finer ribs, which, however, might rather be called strong striæ of growth. In specimens exceeding a diameter of 20 mm. thin spines are formed by the principal ribs on the outer margin, where the lateral joins the siphonal part of the shell. This outer row of spines increases very quickly in size, whilst the inner ones always remain very small, and on the cast barely perceptible. As the shell grows larger the outer tubercles, which are then very strong and prominent, become more distant and less numerous.

The transversal section of the whorls is decidedly squarish, very little broader than high. The umbilicus is very wide, the whorls barely touching, only attached to each other by the flat siphonal side of the foregoing whorl.

The lobes are not visible, as nearly the whole specimen is covered with its shell.

The measurements are—

Diameter of the shell, about	75 mm.
„ of the umbilicus	35
Height of the aperture	24
Thickness of the „	25

Remarks.—The only specimen of this species has been collected in the brown ferruginous oolite of the horizon of *Asp. perarmatum* north-west of Jara.

The nearest allied species is, it seems, *Asp. Tietzei*, Neum., which in a young stage of growth has also the inner row of spines earlier and better developed than the outer one, but those spines stand nearer to the umbilical margin and remain yet predominant in larger specimens when they have already nearly disappeared in *Asp. tenuispinatum*. Larger specimens cannot be mistaken one for the other, as the species from Kachh has then thick strong tubercles on the outer margin. From *Asp. perarmatum* our species differs by the weakness of the inner tubercles, which appear, however, already at a much earlier stage of growth.

Lastly, the differences from *Asp. Edwardsianum* lie in the much smaller number of spines on the outer margin, and in the much narrower siphonal side of *Asp. tenuispinatum.*

(c). *Group of* ASPIDOCERAS PONDEROSUM, *Waagen.*

1. ASPIDOCERAS PONDEROSUM, *Waagen, n. sp.* Pl. XX; Pl. XXI, Fig. 2.

As of nearly all the other species in the bed of *Pelt. athleta,* so also of this species only fragments have been found, but sufficiently preserved to admit of an exact description and determination.

The general form of the species is coronate, with enormous tubercles on either side of the whorls, and an extremely deep infundibuliform umbilicus. The youngest stage of growth is preserved in none of the specimens at my disposal; the smallest size I can observe is about 15 mm. diameter, when the sides of the whorls are covered with distant, simple, rather strong ribs, which bear a small tubercle on the outer end. At about 25 mm. diameter a second row of tubercles near the umbilical margin is added, and in this stage the shell has very much resemblance to young specimens of *A. Babeanum*, Orb., but its siphonal side is more depressed and less ribbed. The form changes now very little till a diameter of 70 to 80 mm. is attained; the whorls are very depressed, nearly twice as broad as high, with two rows of very strong tubercles or rounded spines, which are situated very near each other, as the lateral part of the whorl is very narrow, but which amount to barely more than twelve pairs on one circuit. The outer row of tubercles is not adpressed to the ascending wall of the following whorl, but stands free. Specimens exceeding a diameter of 100 mm. bear again a different aspect. The outer row of tubercles, though in smaller specimens appearing before the inner one, and till now being stronger than the latter, rapidly disappears in specimens of the size mentioned, whilst the inner tubercles increase to an enormous extent. The whorl has no more any distinguishable lateral part, but is entirely composed of an extremely broad siphonal part and the umbilical walls. Then only has the species attained its adult shape which is not changed again.

The lobes are throughout of the common *Aspidoceras* type. The siphonal lobe is long, rather narrow, with short ramifications; the external saddle is extremely broad, occupying nearly one-half of the whole extent between the siphonal and the sutural lobe, with a very small secondary lobe about the middle of it; first lateral lobe very narrow, and very little ramified, about as long as, or a little shorter than, the siphonal lobe, terminating in three unequal branches, situated as in many other *Aspidoceras* between the two rows of tubercles; first lateral saddle rather broad, a little shorter than the external, without any distinct secondary lobe; second lateral lobe very small and short, separated by a tolerably broad saddle from a small auxiliary lobe; sutural lobe yet entirely above the umbilical suture, narrow, rather long, terminating in three nearly symmetrical branches.

The dimensions of the largest tolerably complete specimen are the following :—

Diameter	of the shell	150 mm.
,,	of the umbilicus	65
Height	of the aperture from the umbilical suture	59
,,	of the ,, from the preceding whorl	54
Thickness	of the ,, between the tubercles	85
,,	of the ,, on the tubercles	103

The specimen is composed entirely of air-chambers.

Remarks.—This beautiful species seems to be not very rare in the Kachh Jura, and Dr. Stoliczka tells me that fragments of it are nearly everywhere to be found, where the *Athleta* bed is exposed. In our Museum it is represented from the following localities: north-west of Jara, north of Soorka hill, the figured specimen, in a grayish-white marly limestone, the shell converted into black kalkspar, in some places, however, in the innermost layers iridescent like mother-of-pearl. Another tolerable specimen has been found on the south-west side of Keera hill near Charee; a compressed, but tolerably complete small specimen comes from west of Barasir, and is preserved in a sandy marl nodule; a small fragment of an outer whorl has been collected in the *athleta*-bed at Vanda.

The general appearance of *Asp. ponderosum* is so characteristic that the species is not likely to be mistaken; however, some remarks about its relations to other forms may be useful. Small specimens have a certain resemblance to *P. athleta*, only the innermost whorls have not those sharp ribs which are characteristic for young specimens of this species; but also the outer whorls are much broader, the two rows of spines nearer together, and the spines themselves stronger and more prominent. Adult specimens of both species, however, are so different that they do not allow of any comparison. From *Asp. Babeanum*, Orb., our species can be distinguished by the more depressed whorls, stronger tubercles, and smooth siphonal part of the shell in a young stage of growth; by the extremely broad transversal section of the whorls and enormous development of the inner tubercles in adult specimens.

2. ASPIDOCERAS BABEANUM, *Orbigny*. Pl. XIX.

1847. *Ammonites Babeanus*, Orbigny: Paléont. Franç. Terr. Jurass., Vol. i, p. 491, pl. 181.

Two excellent large specimens represent this species in our Museum, and give a fair idea of its shape and development.

The general form of the species is thick, patelliform, with a wide and deep umbilicus, depressed whorls, and a more or less flattened siphonal side. The sides of the whorls are provided with two rows of spines, of which the outer one is obliterated on the last circuit.

I cannot examine the first stages of growth of the species, as the innermost whorls in the specimens at my disposal are not preserved. At a diameter of 25 mm. two rows of spines on either side of the whorls are already well developed, though the spines themselves are not very prominent. The corresponding spines of the different rows are connected together with high ribs, nearly as high as the spines. At this size the outer row of spines seems a little stronger than the inner, but soon the inner spines increase considerably in strength and become predominant over the outer ones. The greatest transversal diameter of the whorls, therefore, lies on and between the inner spines; from there the lateral parts of the whorl slope towards the siphonal part, with which it unites in an obtuse ridge on which the outer tubercles are placed. The siphonal part of the shell is in all stages of growth rather flat, and not so strongly prominent as in Orbigny's side-view, which is greatly exaggerated. The front-view, however, seems tolerably correct, as the transversal section of the whorl is there squarish, oblong, with depressed siphonal part, which is in accordance with nature. At a diameter of about 100 mm. the outer tubercles are already very small and weak, the lateral part of the whorls becomes gradually more sloping and less distinct from the siphonal part, and at 160 mm. diameter nearly the last trace of the outer tubercles has gone. The inner tubercles, on the contrary, increase in size at the same rate as the outer ones disappear, and one of the largest of them has 22 mm. in diameter at its base. The spines are all hollow, and as well pointed, if in the state of casts, as if provided with shell; their number is somewhat variable, but rarely less than seventeen pairs on one circuit.

The form of the lobes in the Indian specimens is pretty nearly identical with that drawn by Orbigny, especially if one considers that there are variations of their shape in one and the same individual according to the different arrangement of the spines in different parts of the shell. The siphonal lobe is tolerably broad and very long, terminating with four principal branches; external saddle extremely broad, divided into two unequal parts by a large secondary lobe; the outer part is narrower, without distinct secondary lobe; inner part broader, with a small secondary lobe; first lateral lobe a little shorter than the siphonal, very narrow, and terminating in four unsymmetrical branches; lateral saddle rather broad, with a very small secondary lobe; on the whole, about in the same line with the external saddle; second lateral lobe rather long, but extremely narrow and reduced; this is followed by a rather broad and well developed auxiliary lobe, which makes in its direction an angle with the foregoing; the well developed sutural lobe stands yet entirely above the umbilical suture.

The dimensions of two specimens are the following :—

	I.	II.
Diameter of the shell	180 mm.	218 mm.
" of the umbilicus	80	96
Height of the aperture from the umbilical suture	64	76
" of the " from the preceding whorl	59	70
Thickness of the " between the spines	85	(?)98
" of the " on the spines	(?)120	?

Both specimens are composed of air-chambers to the end.

Remarks.—The locality at which both examples of this species have been collected is Vanda. They occur there in a very hard brown oolite, the same bed, in which also excellent specimens of *Asp. perarmatum* have been found.

The position of the species in Europe is quite the same as here; it lies in lower Oxfordian strata. I myself collected it once at the "Vaches noires" in a dark brownish-gray oolite together with many specimens of *Pelt. Arduennense* and *Constanti*, just above the shales with *Pelt. athleta.*

The species is easily distinguishable from the allied forms, as *A. perarmatum* or such species; it however, resembles more closely *A. ponderosum*, W., just now described by myself. From this species, *Asp. Babeanum* can be distinguished by the predominance of the inner row of spines already in tolerably young specimens, the sloping of the lateral parts of the shell towards the siphonal side, and less depressed whorls. In other species, which could be compared, like *A. eucyphum*, etc., not only the disappearance of the outer row of tubercles in full grown specimens is not yet fixed, but further the spines are not hollow as in Orbigny's species, and in consequence of this are on the casts only represented by rounded tubercles.

The name I have chosen for the species requires yet some remarks. In 1830 Zieten described a little Ammonite under the name of *A. biarmatus* as coming from the "Lias Schiefer" of Boll, which was found, however, without any doubt to belong to the zone of *A. Lamberti* in the neighbourhood, and has been identified by Oppel partly with *Amm. Babeanus*, Orbigny, but this author never stated if he thought the specimens figured by Orbigny were identical with Zieten's species or only other specimens mentioned in the text. It is impossible to decide the question about the identity of both species without examination of Zieten's original specimen, as his figure is too imperfect to allow of a close comparison. As the matter stands thus, I was obliged to abstain from any attempt to settle the question, and used Orbigny's name, as his figures represent exactly the form which the Indian species exhibits.

3. ASPIDOCERAS SPARSISPINUM, *Waagen, n. sp.* Pl. XVIII.

In its general form this species keeps about midway between *A. perarmatum* and *A. Babeanum;* it is, however, more nearly allied to the latter one, on account of its losing the outer row of spines in full-grown specimens.

The species is, like the foregoing one, thick, patelliform, with deep umbilicus and depressed whorls, which are covered on either side with two rows of spines. I cannot state what appearance young specimens may have had, as the inner whorls of the specimen I have for examination are destroyed. In large specimens the spines of the different rows are about equal in strength, the lateral part of the shell not sloping towards the siphonal side, and the single pairs of spines very distant from each other, so much so that only twelve pairs can be counted on one circuit. The transversal section of the whorls is squarish, oblong, a little broader than high; the siphonal side smooth, and tolerably flat.

The lobes are not visible.

The dimensions of the specimen from Vanda are—

Diameter of the shell	170 mm.
" of the umbilicus	80
Height of the aperture from the umbilical suture	61
" of the " from the preceding whorl	56
Thickness of the " between the spines	63
" of the " on the spines, about...	83

The species lost its outer row of spines only very late in its growth, as in the specimen of which I just have given the measurements, this row is only just beginning to become weaker.

Remarks.—The only specimen of this species has been found in the oolites with *Asp. perarmatum* at Vanda.

Asp. sparsispinum is closely allied to two formerly described species, that is, to *A. Babeanum* and *A. perarmatum.* From the former our species is distinguishable by more squarish whorls, the lateral parts of which do not slope towards the siphonal side, and less numerous spines, which count only twelve pairs in our species, whilst there are seventeen to eighteen in *A. Babeanum*. From *A. perarmatum* the species differs by its much broader whorls and spines, of which the outer row gets slowly weaker, and the inner one increases in size, whilst in Sowerby's species the contrary is the case. *Asp. sparsispinum* must be placed in the group of *Asp. ponderosum* on account of the disappearance of the outer tubercles in larger specimens, but in many other respects it shows great analogies to the group of *A. perarmatum*, and furnishes thus in reality a connecting link between the two groups.

(d.) Group of ASPIDOCERAS EDWARDSIANUM, *Orb.*

1. ASPIDOCERAS SUBDISTRACTUM, *Waagen, n. sp.* Pl. XXI, Fig. 1*a*, *b*.

I was for a long time inclined to describe the specimen, which I consider now to represent a new species, as *Asp. Rupellense*, Orb., but after having exposed, with great labour, the inner whorls and the long spines which cover them, I came to the conclusion that it forms a species intermediate between that of Orbigny and *Asp. distractum*, Quenst.

The innermost whorls are destroyed by weather action, and only at a diameter of about 15 mm. the shape of the shell begins to become clearly visible. The last whorl is, at this diameter, about 5 mm. high, with flat lateral and flat siphonal parts, rather compressed, with a row of thin, very acute, straight spines along the umbilical margin, and another row of spines on the outer margin, which latter, however, are very long, slightly curved and turned backwards. The sides of the whorls are nearly perfectly smooth, only with slight traces of flattened ribs connecting the corresponding tubercles of the different rows. The form of the shell just described remains up to a diameter of about 40 to 50 mm. Then a change is effected by the inner row of tubercles becoming more and more distant from the umbilical margin. The whorls get more compressed as the species grows larger, and are at last a good deal higher than broad.

The siphonal side is narrow, flatly rounded, and assumes somewhat the appearance of being excavated by the outer spines, forming an angle of about 45° with the siphonal part of the shell.

The spines themselves, as well those of the inner as those of the outer row, are all hollow, but separated from the inner space of the tube by a layer of shell, shutting them up at their base. Thus the fossil, if the shell is lost, appears without any spines, but with thick rounded tubercles on the outer margin, and very small, barely prominent, ones near the umbilicus.

The umbilicus is always wide open, with tolerably perpendicular walls in small specimens, but with very oblique ones in adult examples. The umbilical suture runs always strictly along the outer row of tubercles of the preceding whorl, and the corresponding spines are for the greater part of their length firmly adpressed to the umbilical wall.

The lobes are very badly preserved and only partly visible, but one can observe, that there is a long and rather narrow siphonal lobe, a very broad external saddle, and a narrow first lateral lobe, not as long as the siphonal, and situated between the two rows of spines; whether a second lateral lobe exists or not is not visible.

The measurements are the following :—

Diameter of the shell	88 mm.
" of the umbilicus	37
Height of the aperture from the umbilical suture	32·5
" of the " from the preceding whorl	32
Thickness of the "	25

Remarks.—The only specimen of this species has been collected at Gangta Bét, an island in the Runn, in a greyish-yellow, very hard sandstone, of very likely middle or upper Oxfordian age.

Asp. subdistractum is of a certain interest, as it furnishes the connecting link between two species, of which the one occurs in Europe in lower Oxfordian, the other in Kimmeridgian beds, whilst in the intermediate strata no transitional species was known. This is represented by our species, which is equally allied to ***Asp. distractum*** as to ***Asp. Rupellense***, without agreeing entirely with either of them.

From the former species ***Asp. subdistractum*** is distinguishable by the existence of an inner row of spines, and by the structure of all the spines, which are, though being hollow, shut off at their base by a layer of shell, separating them from the remainder of the tube, which is not the case in Quenstedt's species, which has got simple hollow spines. From ***Asp. Rupellense*** the Indian species differs also by the existence of an inner row of spines already in a young stage of growth, by the outer spines being thin, slightly curved and turned backwards, and by much more compressed whorls.

From other species of the group, like ***Asp. Edwardsianum, Meriani,*** or ***corona,*** the Indian form is always easily to be distinguished, at least so far as up to this moment the knowledge of these species extends. When we once know the adult form of ***Asp. Meriani*** or ***corona*** the relations between these species and ***Asp. subdistractum*** will possibly be found closer than they appear now.

Section II.—HYBONOTI.

(a.) Group of Aspidoceras pressulum, *Neum.*

1. Aspidoceras monacanthum, *Waagen, n. sp.* Pl. XXI, Fig. 3*a*, *b*.

It is with great doubt that I propose this new name for a species which in our Museum is only represented by a small and not very brilliantly preserved fragment. However, the occurrence of a species of the section ***Hybonoti*** in the Kachh Jura, and its geological position there on about the same horizon as the ***Hybonoti*** generally are found to occupy in Europe, is of so high an interest that a name seemed to be necessary for the Indian form.

The fragment I have for description is a piece of the body-chamber of an individual of about 130 to 140 mm. in diameter. The whorl is compressed, the aperture nearly twice as high as broad, the largest transversal diameter being near the umbilical margin, where thick equidistant tubercles are situated, from which very indistinct ribs go towards the outer margin. The ribs are broad, low, somewhat falciform, and bent strongly towards the front a little above the middle of the sides. Besides the ribs, which start from the tubercles, there are yet other fainter ones intercalated, which are, however, only visible near the outer margin.

The siphonal side is flatly excavated, bearing on each side of the excavation a low broadly rounded ridge, each of which is provided on its top with a very indistinct crenulation corresponding with the ribs which come up from the sides of the whorl. This crenulation is stronger and more distinct on the inner than on the outer whorl. Except the tubercles the whole sculpture is extremely weak in the specimen I have for description, but that may partly depend upon the preservation of the fragment.

Remarks.—The only fragment of this species has been found by Mr. Fedden in a yellowish-gray conglomeratic sandstone of the Katrol group west of Katrol range.

Of the species of the *Hybonoti* as yet described there is one very nearly allied to the Kachh form, that is, *Asp. harpephorum*, Neum. This species is, however, easily distinguishable by a different arrangement and stronger prominence of the ribs. But another species figured by Dr. Neumayr on the same plate, but not named, could be considered identical with *Asp. monacanthum*, as it differs apparently only by somewhat stronger ribs. This was found in the beds with *Asp. acanthicum* at Gylkos-kö in Transylvania.

2. Aspidoceras, *species indeterminata.* Pl. XXI, Fig. 4*a*, *b*.

There is yet another fragment which indicates a species related to *Asp. hybonotum*, Opp., and which has been found south of Booj on the road to the Charvar range in the lowest beds of the Katrol group, a brownish ferruginous sandstone. It is very likely the oldest species, geologically, of the group, possibly of upper Oxfordian age, and in so far interesting, as it is yet very nearly allied to *A. perarmatum*.

The fragment consists only of a part of the body-chamber of a rather large specimen. The transversal section of it is somewhat rectangular, higher than broad, with its greatest breadth on the umbilical margin. The sides of the whorl are flat, with two rows of fine spines or tubercles, one on the umbilical and another near the outer margin; the spines of the inner row are considerably stronger than those of the outer one; the corresponding spines of the different rows are connected together by very slight, flattened, ribs, which go yet from the inner tubercle down to the umbilical suture. The flat siphonal part bears a broad, very slight excavation, which is not provided with any granulation on either side.

The fragment is too imperfect to allow of giving a name, but I thought it not uninteresting to mention it, as it furnishes possibly some reason for tracing the descent of *Asp. hybonotum* from *Asp. perarmatum.*

Section III.—CYCLOTI.

(a.) Group of ASPIDOCERAS LONGISPINUM, *Sow.*

1. ASPIDOCERAS IPHICEROIDES, *Waagen, n. sp.* Pl. XXIII.

1871. *Aspidoceras iphicerum*, (Opp.) Waagen: Records, Geol. Surv. of India, Vol. iv, p. 92.

In the short extract of the results of the examination of the collection of Kachh Ammonites at that time in the possession of our Museum, I noticed a specimen coming from north of Dhosa as *Asp. iphicerum*, Opp. Since then some other specimens have been obtained, which enabled me to determine the species more exactly and led me to distinguish it from Oppel's species under the above name.

Asp. iphiceroides is no very large species, attaining scarcely more than 150 mm. in diameter; the whorls are inflated, the umbilicus deep, the siphonal side prominent, broad, rounded.

The form of the species is rather variable according to size. Very small specimens up to a diameter of about 15 to 20 mm. are nearly entirely smooth and increase very slowly in size. If the shell is preserved, very fine isolated spines are here and there observable on the umbilical margin, the first of them being about at a diameter of 10 mm. Yet scarcer are spines of a similar description which indicate an outer row, but appear sometimes a little earlier, sometimes later, than the inner ones. At a diameter of about 20 mm. the spines of the two rows begin strictly to correspond with each other, and I observe on a specimen of 40 mm. diameter seven pairs of spines on one circuit. In the single pairs the spines are not connected by a rib, but stand isolated, though rather closely together, which causes the siphonal part of the shell to appear far projecting. The spines are long, very thin, and the tubercles, which replace them on the cast, are as yet barely perceptible. In very young specimens, the casts, therefore, appear entirely smooth, but in examples exceeding a diameter of 50 mm., the cast also bears rather strong rounded tubercles. The shell shows a few slight folds between the tubercles, which extend to the siphonal part of the shell and cause there some slight undulations. In full grown specimens even on the cast such undulations can sometimes be observed.

The correspondence of the tubercles is not constant during the whole lifetime of the species, but sometimes two outer tubercles correspond to one inner one, sometimes two inner to one outer one, and principally on the body-chamber they become rather irregular.

The species does not seem to become very large, specimens of 150 to 180 mm. diameter are apparently already full grown. The body-chamber occupies a little more than half a circuit, and differs in its sculpture by its rather prominent undulations on its lateral and siphonal parts, and by the irregularity of the tubercles. The apertural margin of the shell is not preserved.

The lobes are of the common shape, as in other *Aspidoceras*, differing only in smaller details. The siphonal lobe is rather broad, not very long, with four short branches on either side; external saddle not very broad; with a small eccentrical secondary lobe, shifted towards the first lateral; first lateral lobes very broad, fan-shaped, with five nearly symmetrical terminating branches, not quite as long as the siphonal; first external saddle tolerably narrow with a somewhat eccentric, small secondary lobe, shifted towards the first lateral; second lateral lobe much shorter than the first, terminating in four somewhat unsymmetrical branches, situated between the two rows of tubercles; second lateral saddle broad, with a broad but short secondary lobe; two rather large auxiliary lobes above the umbilical suture.

The measurements of three specimens are—

	I.	II.	III.
Diameter of the shell	41 mm.	82 mm.	142 mm.
" of the umbilicus	10	23	42
Height of the aperture from the umbilical suture	18	37	66
" of the " from the preceding whorl	14	27	51
Thickness of the "	22·5	47	73

Remarks.—Asp. iphiceroides is represented by three specimens in our Museum, two of them coming from north of *Dhosa* out of a soft sandstone with iron nodules, the third from the *Charvar range*, south of *Bhooj*, out of a bed of similar mineralogical character, all those lying immediately above the oolites with *Asp. perarmalum*.

The species resembles several of the *Aspidoceras* previously known, and principally *Asp. iphicerum*, Opp. From all the *European* forms, however, which could be compared (except *Asp. atavum*), the Indian species is distinguishable by a less flattened and more prominent siphonal side, by tubercles much less numerous, of which the two rows, however, are much closer together. From *Asp. atavum* our species differs by the want of ribs between the corresponding tubercles of the different rows, the more rounded whorls, and the greater number of spines.

The general shape of this species would, if found in *European* territories, indicate beds of Kimmeridgian age. It is probable that it does the same here in India.

2. ASPIDOCERAS WYNNEI, *Waagen, n. sp.* Pl. XXI, Fig. 5*a*, *b*; Pl. XXII.

In my short extract published in the Records of our Survey, I compared this species with *Asp. Appenninicum*, Zittel, but I find now from two small specimens collected subsequently by Dr. Stoliczka that the affinity to *Asp. longispinum*, Sow., is much greater; only the full-grown stage of *Asp. Wynnei* shows, like *Asp. Appenninicum*, the outer row of spines placed on the outer margin.

Of the first stages of growth, up to a diameter of 30 mm., only casts are at my disposal, and they appear nearly entirely smooth with scarcely any indication of tubercles, a tolerably wide umbilicus, surrounded by perpendicular walls, and rounded whorls. At the indicated diameter, however, rather strong spines, which are also well distinguishable as tubercles on the cast, are formed, and arranged in two rows, one on the umbilical, and another not far from the outer, margin. The rows are more distant from each other than in the preceding species.

In tolerably large specimens there are nine to ten pairs of spines observable on one circuit. The pairs, however, are not quite equidistant, and often there are on the outer row one or two spines more than on the inner.

A short distance before the body-chamber begins, the spines of both rows increase rapidly in size, and the outer one of them approaches more and more the outer margin, in consequence of which the siphonal part of the shell becomes flatter and less prominent. In a specimen with preserved shell of about 160 mm. diameter from each of the excessively long and thick spines of the outer row of the last circuit start several flat folds, which unite with the corresponding tubercle of the inner row, if one is present, and then disappear again. On the siphonal side there are also a number of very faint flat folds or undulations visible, which start irregularly from the tubercles on either side.

If the shell is very perfectly preserved one can observe on the siphonal part three different layers of which it is composed. The innermost is 2 mm. thick and converted into transparent kalkspar, and has certainly formed formerly the nacreous part of the ammonite shell. It is slightly undulated, but not striped. Above this comes a layer, thin like paper, untransparent, and covered with numerous transversal, sharp and slightly prominent lines. The last layer is again very thin, not transparent, but entirely smooth.

The lobes are very roughly dentated. The siphonal lobe is rather long and not very broad, not quite symmetrical; external saddle rather narrow, divided by a secondary lobe into two unequal parts, of which the inner one is much shorter than the outer; first lateral lobe much shorter than the siphonal, but hanging so far down that the ends of both come nearly in the same line, narrow at its base, with a somewhat broader, rosette-shaped end; first lateral saddle much shorter than the external, with a very small, median secondary lobe; second lateral lobe shorter than the first, otherwise about of the same shape as the latter, only more unsymmetrical; second lateral saddle like the first; two very small auxiliary lobes above the umbilical suture.

The measurements are not easy to take, as the specimens are all more or less altered by compression. As far as one can make them out, they are in two specimens the following :—

	I.	II.
Diameter of the shell	95 mm.	165 mm.
„ of the umbilicus	29	62
Height of the aperture from the umbilical suture	40	63
„ of the „ from the preceding whorl	32	54
Thickness of the „	47	62

Remarks.—All the specimens of this species which exist in our Museum have been collected at Jadoora in the Katrol range in a ferruginous band just above the Oomia conglomerate, the lowest part of the Oomia group.

The affinities of ***Asp. Wynnei*** to ***Asp. longispinum*** (= ***Asp. iphicerum***) are striking in half grown specimens, the distance of the two rows of spines, the prominence of the siphonal side, the inflated whorls, being equal in both species, but the former stages of growth as well as full-sized specimens show sufficient differences for the distinction of the European and the Indian form. Small examples differ from ***Asp. iphicerum*** by the thin scanty spines, if the shell is preserved, and by the want of even tubercles on the cast, whilst full grown specimens are distinguishable by the irregularity of their enormous spines, the folds, which run from one spine to the other, and the more depressed siphonal side, by which latter peculiarity it approaches more nearly to the shape of ***Asp. Appenninicum***, Zitt.

From the before described species ***Asp. Wynnei*** is also distinguishable by the stronger spines, the two rows of which are more distant from each other, and by the more depressed siphonal side. Other species of ***Aspidoceras***, which could be compared, such as ***Asp. acanthicum***, etc., are not easily mistaken for our species.

(*b.*) *Group of* ASPIDOCERAS ATAVUM, *Opp.*

1. ASPIDOCERAS BINODIFERUM, *Waagen, n. sp.* Pl. XXIV.

This species grows to a very considerable size, and is the most conspicuous among the Indian ***Aspidoceras***. In its general form it is thick, inflated, with a tolerably wide umbilicus, and two rows of tubercles on either side.

I cannot examine the very first stages of growth, as the innermost whorls of the specimens I have for description are destroyed by weather-action; but at a diameter of about 20 mm., already a row of very strong tubercles, prominent even on the cast, is visible a short distance from the umbilical margin, whilst on the margin itself only weak traces of tubercles can be detected. Only when exceeding the mentioned diameter the shell becomes provided with a distinct inner row of tubercles, which then remains constant up to the end of the body-chamber. The two rows of tubercles are very close together, and the corresponding tubercles of the different rows are mostly connected together by broad low ridges. The number of tubercles is rather large, but not equal in both rows, as the outer row counts many more than the inner, and thus very often two outer tubercles correspond to one inner one. The siphonal side is high, rounded, strongly prominent, more so in the outer whorls than in the inner. The umbilicus is tolerably wide, deep, surrounded by perpendicular walls, which do not form, however, an umbilical edge as in ***Asp. binodum***, Opp.

The lobes are characteristic, but badly preserved. The siphonal lobe is broad and not very long, with four short branches on either side; external saddle rather broad, divided by a not very large secondary lobe into two unequal parts, of which the outer one is much longer than the inner; first lateral lobe broad, fan-shaped, terminating in five short branches, shorter than the siphonal, but hanging down so far that the ends of both are in the same line; first lateral saddle tolerably broad with a well developed secondary lobe; second lateral lobe long, little shorter than the first, narrow; second lateral saddle very broad with two small secondary lobes; two well developed auxiliary lobes above the umbilical suture.

The dimensions of a specimen with nearly entire body-chamber are as follows:—

Diameter of the shell	210 mm.
„ of the umbilicus	69
Height of the aperture from the umbilical suture	87
„ of the „ from the preceding whorl	66
Thickness of the „	96

The length of the body-chamber occupies a little more than half a whorl.

Remarks.—The only specimen of this species has been found in the lower beds of the Katrol group in a sandstone with iron nodules north of *Dhosa*, together with *Asp. iphiceroides.*

Asp. binodiferum is very closely allied to *Asp. binodum,* Quenst., and I was for a long time doubtful, if I should not unite both species, but at last the more depressed shape of the whorls and the presence of an umbilical edge in Quenstedt's species led me to distinguish the Indian form. From *Asp. iphiceroides* the present species is distinguishable by stronger and more numerous tubercles, which begin already at an early age, by the much more considerable size the species attains, and by the lobes, in which the different shape of the external saddle is most conspicuous. Whilst in *Asp. binodiferum* this part agrees with the shape shown in the lobes of *Asp. Wynnei,* it is much more symmetrical in *Asp. iphiceroides.* From *Asp. atavum* the present species differs by much more numerous tubercles, from *Asp. longispinum* and allied forms by the narrow lateral sides of the shell, and the strongly prominent siphonal part.

2. ASPIDOCERAS, *species indeterminata.*

A fragment, coming from the sandstones with iron nodules of the Katrol range, (middle region of the Katrol group) shows great affinities to *Asp. binodum,* Quenst., exhibiting a tolerably depressed siphonal and very narrow lateral parts, which are limited below by an indistinct umbilical edge; the lobes, however, seem to be more complicated than in Quenstedt's species.

I mention this fragment because the locality is interesting, and also because it certainly indicates yet another species of the group of *Asp. atavum* besides the one described above.

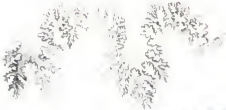
PLATE XV.

Fig. ... 1. **Peltoceras bidens**, *Waagen*, n. sp., p. 85; figure two-thirds of natural size, of a specimen with the beginning of the body-chamber, from the *Dhosa oolite* of *Lodai*.

Fig. ... 2. **Peltoceras bidens**, *Waagen*, n. sp., p. 85; 2, lobes; 2*a*, section of the inner whorl, natural size; from the specimen represented in fig. 1 in reduced size.

Fig. ... 3. **Peltoceras bidens**, *Waagen*, n. sp., p. 85; fragment of a half grown specimen from the *Dhosa oolite* of *Lodai*; 3*a*, side-view; 3*b*, back-view.

Fig. ... 4. **Peltoceras bidens**, *Waagen*, n. sp., p. 85; fragment of a small specimen from the *Dhosa oolite* of the *Joora hills*; 4*a*, side-view; 4*b*, section of the whorls.



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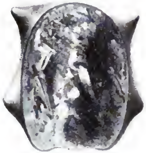

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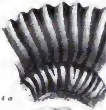

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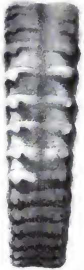

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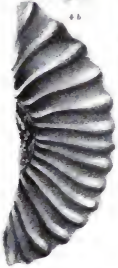

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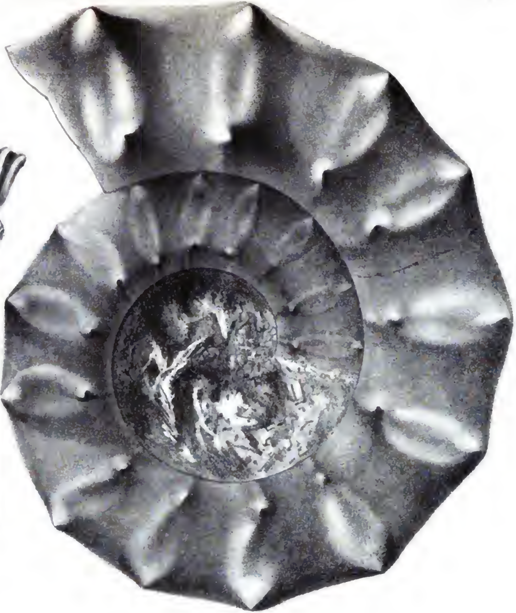

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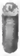
PLATE XVI.

Fig. ... 1. **PELTOCERAS PROPINQUUM**, *Waagen*, n. sp., p. 79; specimen, without preserved shell, entirely composed of air-chambers, from the *Dhosa oolite* north-west of *Kumagúna;* 1*a*, side-view; 1*b*, front-view; 1*c*, portion of the siphonal side of the latter end of the last whorl.

Fig. ... 2. **PELTOCERAS ARDUENNENSE**, *Orbigny*, p. 79; small specimen; from the *Dhosa oolite* of the *Joora hills;* 2*a*, side-view; 2*b*, front-view.

Fig. ... 3. **PELTOCERAS AEGOCEROIDES**, *Waagen*, n. sp., p. 78; apparently full grown specimen, with partly preserved body-chamber, from the *Dhosa oolite* of the *Joora hills;* 3*a*, side-view; 3*b*, front-view.

Figs. ... 4—7. **ASPIDOCERAS PERARMATUM**, *Sowerby*, p. 91; 4 *a*, *b*, middle-sized specimen from the *Dhosa oolite* of *Vanda*, front and side-views; 5 *a*, *b*, very young specimen from the same bed and locality as fig. 4, front and side-views; 6, somewhat larger specimen, also from the *Dhosa oolite of Vanda*, side-view; 7, lobes of a full grown specimen, from the *Dhosa oolite* of *Lodai*.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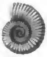
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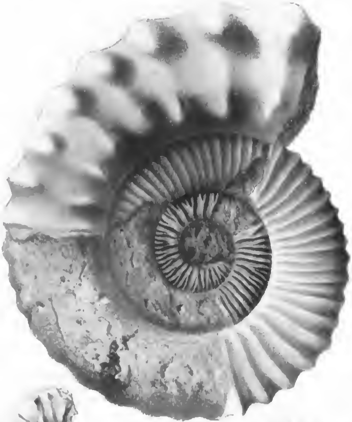
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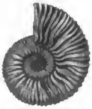
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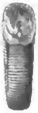
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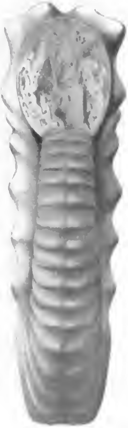
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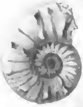
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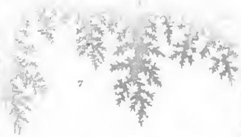
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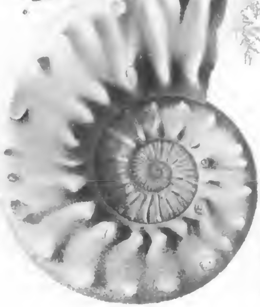
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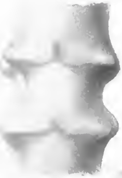
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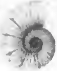
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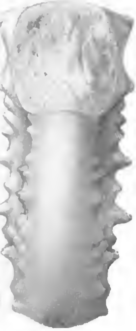
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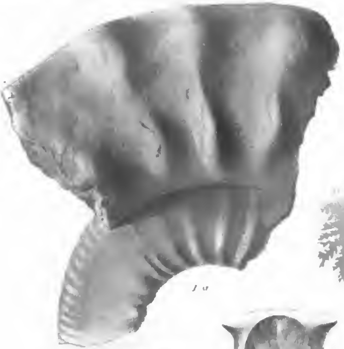
PLATE XVII.

Fig. ... 1. Aspidoceras diversiforme, *Waagen*, n. sp., p. 90; fragmentary specimen with preserved shell, entirely composed of air-chambers, from the *Athleta beds* of north-east of *Gudjinsir;* 1*a*, side-view; 1*b*, section of the outer whorl; 1*c*, impression of the siphonal side of the younger shell left on the antisiphonal side of the inner whorl of the fragment; 1*d*, lobes from the siphonal to the antisiphonal lobe.

Fig. ... 2. Peltoceras athleta, *Phillips*, p. 81; fragment of a middle-sized specimen from the *Athleta beds* of *Gudjinsir;* 2*a*, side-view; 2*b*, lobes.

Fig. ... 3. Peltoceras athleta, *Phillips*, p. 81; fragment with preserved shell from the *Athleta beds* of north of *Gudjinsir;* 3*a*, side-view; 3*b*, back-view; 3*c*, section.

Fig. ... 4. Aspidoceras tenuispinatum, *Waagen*, n. sp., p. 93; fragmentary specimen with, for the greater part, preserved shell from the *Dhosa oolite* north-west of *Jara;* 4*a*, side-view; 4*b*, back-view.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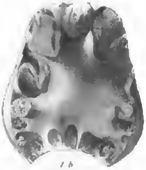
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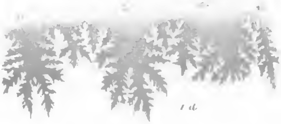
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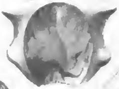
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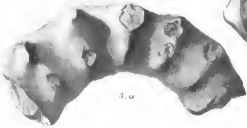
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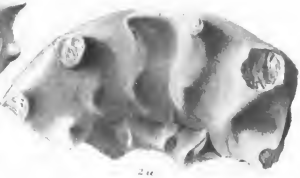
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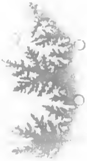
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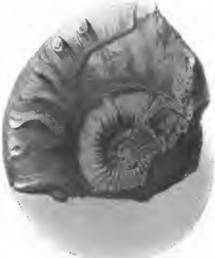
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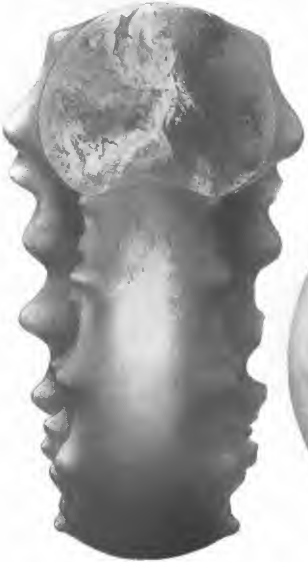
PLATE XVIII.

Fig. .... 1. **Aspidoceras sparsispinum**, *Waagen*, n. sp., p. 98; specimen without preserved shell, with the beginning of the body-chamber, from the *Dhosa oolite* of *Vanda*; 1*a*, side-view; 1*b*, front-view.

Geological Survey of India. JURASSIC CEPHALOPODA FROM KACHH. Pl. XVIII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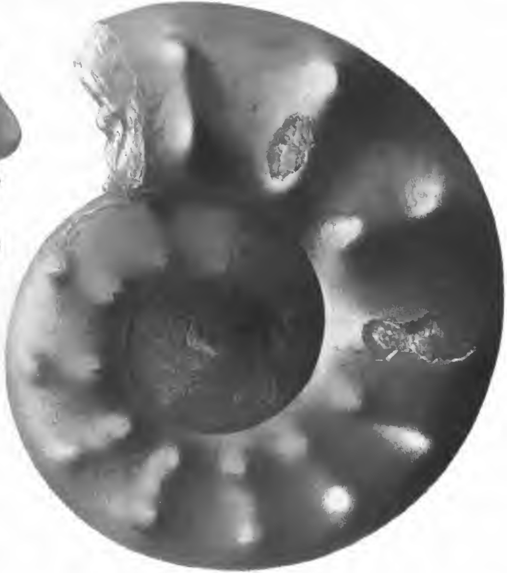
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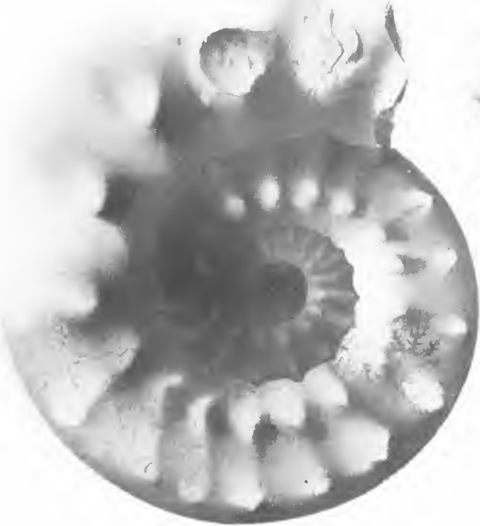
PLATE XIX.

Fig. ... 1. **Aspidoceras Babeanum**, *Orbigny*, p. 95; specimen without preserved shell, without body-chamber, from the *Dhosa oolite* of *Vanda ;* 1*a*, side-view ; 1*b*, front-view.



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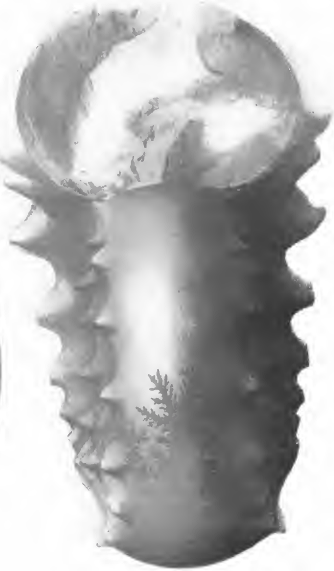

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PLATE XX.

Fig. ... 1. **Aspidoceras ponderosum**, *Waagen*, n. sp., p. 94; fragmentary specimen with preserved shell, entirely composed of air-chambers, from the *Athleta beds* of north-west of *Jara*, north of *Soorka hill*; 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.

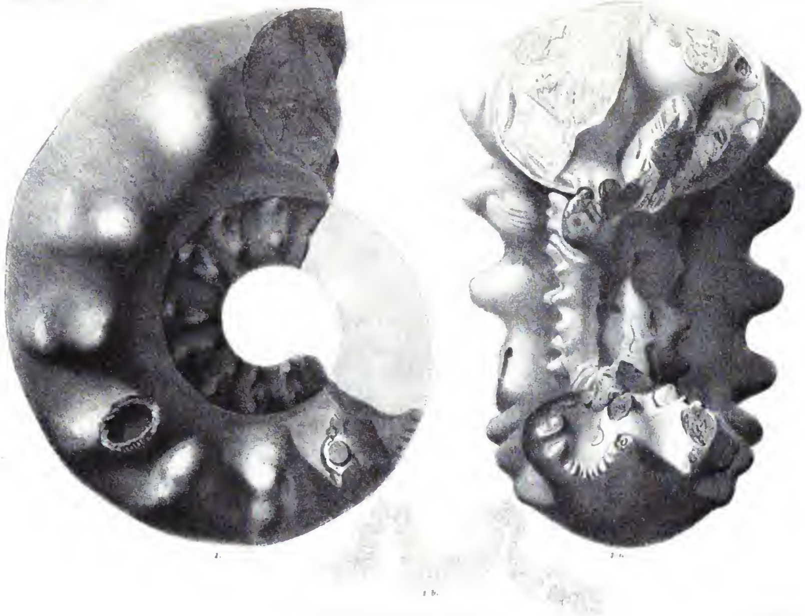

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PLATE XXI.

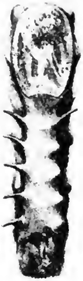
Fig. ... 1. Aspidoceras subdistractum, *Waagen*, n. sp., p. 99; fragmentary specimen with partly preserved shell, entirely composed of air-chambers, from the *Kuntkote sandstone* of *Gangta bét*; 1*a*, side-view; 1*b*, front-view.

Fig. ... 2. Aspidoceras ponderosum, *Waagen*, n. sp., p. 94; small specimen, with preserved shell, from the *Athleta beds* of west of *Barasir*; side-view.

Fig. ... 3. Aspidoceras monacanthus, *Waagen*, n. sp., p. 100; fragment of the body-chamber of a full grown specimen; from the *Katrol group* of the *Katrol range*; 3*a*, side-view; 3*b*, section.

Fig. ... 4. Aspidoceras, *species indet.*, p. 101; fragment of the body-chamber, cast; from the lowest beds of the *Katrol group* of south of *Bhooj*; 4*a*, side-view; 4*b*, section.

Fig. 5. Aspidoceras Wynnei, *Waagen*, n. sp., p. 104; small specimen, without shell, from the *Oomia group* of *Jadoora, Katrol range*; 5*a*, side-view; 5*b*, front-view.



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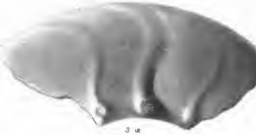

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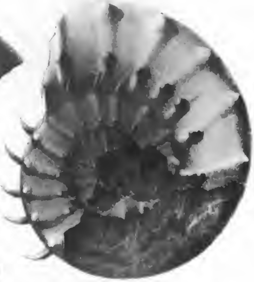

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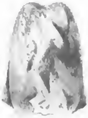

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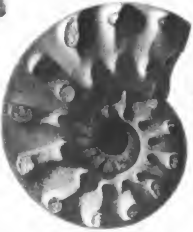

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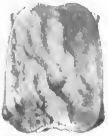

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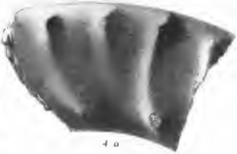

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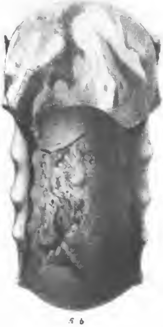

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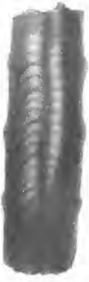

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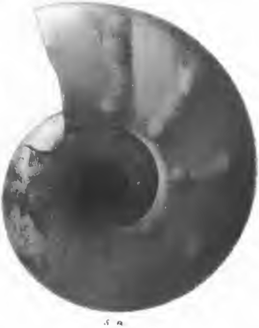

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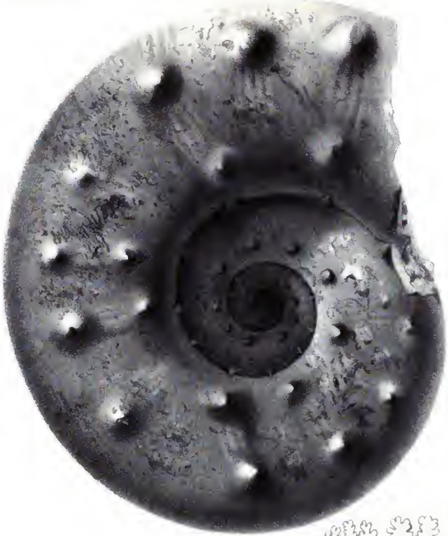
PLATE XXII.

Fig. ... 1. **Aspidoceras Wynnei**, *Waagen*, n. sp., p. 104; specimen, with preserved shell, from the *Oomia group* of the *Katrol range;* 1*a*, side-view; 1*b*, front-view; 1*c*, lobes.



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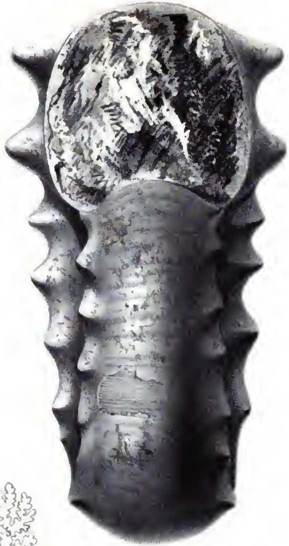

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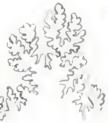

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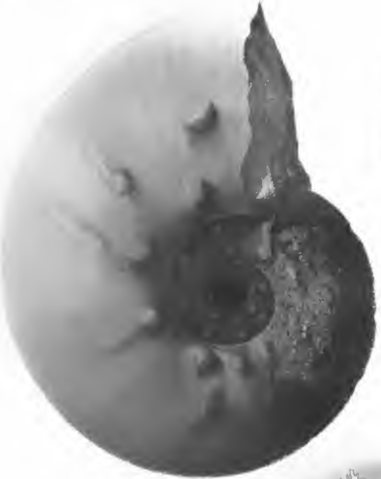
PLATE XXIII.

Fig. ... 1. ASPIDOCERAS IPHICEROIDES, *Waagen*, n. sp., p. 102; specimen without shell, with preserved body-chamber, from the *Katrol group* of north of *Dhosa;* 1*a*, side-view; 1*b*, front-view; 1*c*, lobes (si. siphonal; L. first lateral; *b*, second lateral lobe).

Fig. ... 2. ASPIDOCERAS IPHICEROIDES, *Waagen*, n. sp., p. 102; small specimen, with preserved shell, from the *Katrol group* of the *Charvar range;* 2*a*, side-view; 2*b*, front-view.

JURASSIC CEPHALOPODA FROM KACHH



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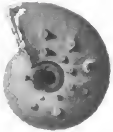

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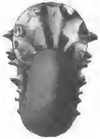

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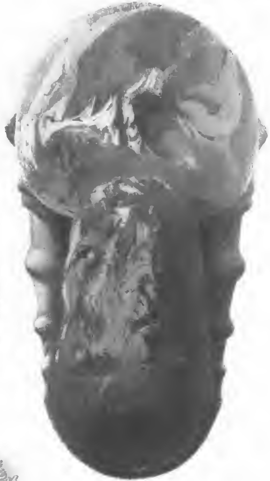

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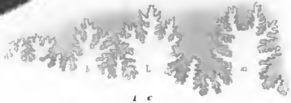

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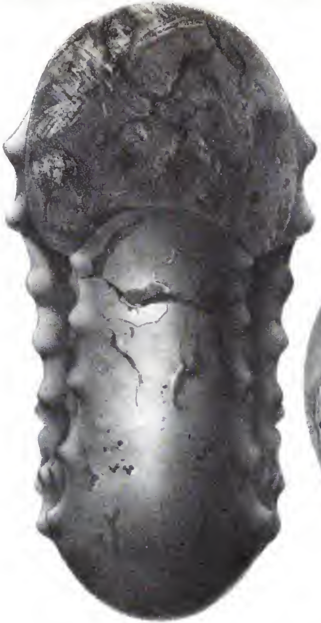
PLATE XXIV.

Fig. ... 1. **Aspidoceras binodiferum**, *Waagen*, n. sp., p. 105; specimen without shell, with the beginning of the body-chamber, from the *Katrol group* of north of *Dhosa*; 1*a*, side-view; 1*b*, front-view.



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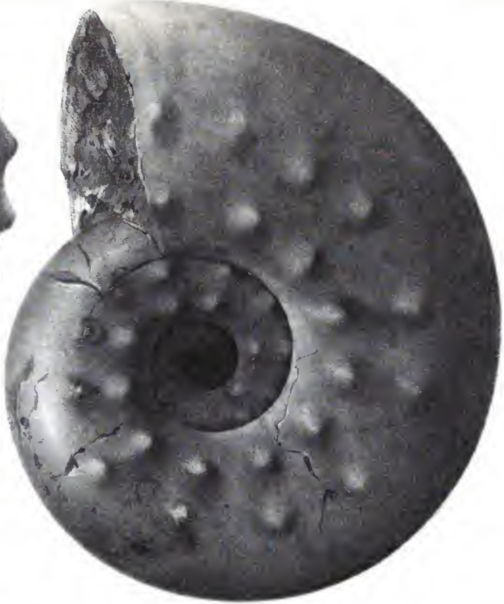

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